“COMPARISION OF FUNCTIONAL OUTCOME BETWEEN TRADITIONAL AND LATERAL CROSSED PINNING IN SUPRA CONDYLAR HUMERUS FRACTURES OF CHILDREN”

Dissertation submitted to

M.S. DEGREE-BRANCH II ORTHOPAEDIC SURGERY

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

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CERTIFICATE

This is to certify that this dissertation **"COMPARISION OF FUNCTIONAL OUTCOME BETWEEN TRADITIONAL AND LATERAL CROSSED PINNING IN SUPRA CONDYLAR HUMERUS FRACTURES OF CHILDREN"** is a bonafide record of work done by **DR.K.NIKHIL RAJ,** during the period of his Post graduate study from June 2015 to August 2017 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfilment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree Examination of The Tamilnadu Dr.M.G.R. Medical University to be held in April 2018.

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DECLARATION

I declare that the dissertation entitled **"COMPARISION OF FUNCTIONAL OUTCOME BETWEEN TRADITIONAL AND LATERAL CROSSED PINNING IN SUPRA CONDYLAR HUMERUS FRACTURES OF CHILDREN"** submitted by me for the degree of M.S ORTHO is the record work carried out by me during the period of May 2015 to September 2017 under the guidance of **Prof. R SELVARAJ**, Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College, Chennai. This dissertation is submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fulfilment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2018.

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Place: Chennai Signature of the Candidate
Date:

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CONTENTS

INTRODUCTION

10 – 15 % fractures in the paediatric age group are around elbow joint .

The distinct anatomy and high rates of complications, difficulty in distinguishing fractures from the six normal secondary ossification centers are associated with fractures around the elbow make their treatment an important study.

By following the basic principles in treating these fractures outcomes can be improved.

Apart from supracondylar humerus fractures the other common fractures around the elbow are fractures of the lateral humeral condyle, transphyseal distal humerus, medial humeral epicondyle, olecranon and radial head and neck.

Among these injuries presenting to emergency the most common are supracondylar fractures . Around 50% to 70% of all elbow injuries are supracondylar fractures, commonly seen in children between the ages of 3 and 10 years.

With regards to management of supracondylar humerus fracture in the paediatric population gold standard of management being closed reduction and pinning for all displaced fractures . There are various pinning techniques like traditional crossed pinning , two lateral pins, three lateral pins, lateral crossed

pins . Among these the biomechanically most sound are the crossed pinning techniques but the traditional technique of crossed pinning carried along with it some disadvantages like the iatrogenic ulnar never injury .

So , we decided to conduct study with the aim to evaluate the functional outcome of a modified technique of crossed pinning comparing it with traditional techniques.

ANATOMY

The elbow joint is an articulation between three bones that allows motion in all three planes between humerus , ulna and radius .

Humerus comprises of the humeral condyle, composed of the trochlea medially from anterior to posterior and the capitulum laterally on the anterior aspect forming the articular surface of the elbow joint.

The humeral condyle is a tube like structure located in central position it is covered by articular cartilage and allows trochlear notch of the ulna and the concave superior aspect of the head of the radius to articulate.

The humerus has two fossa above the condyles on the anterior aspect they are the radial fossa and the coronoid fossa which accommodate the head of the radius and the coronoid process of the ulna in a fully flexed elbow.

On the posterior aspect the humerus above the trochlea has the olecranon fossa, which accommodates the olecranon of the ulna when elbow is fully extended.

On either side of this tubular humeral condyle are the medial and lateral epicondyles just above which are the medial and lateral supracondylar ridges ,these epicondyles and supracondylar ridges are attachment sites for ligamentous supporting structures and muscles which cross the elbow joint and have action on it.

ELBOW Anterior and posterior view showing bony anatomy

Lateral view in extension Medial view in extension

The olecranon process at the proximal end of the ulna, posteriorly acts as an insertion point for muscles crossing the elbow joint and anteriorly, the anteroinferior portion forms what is called the coronoid process.

The radius proximally has the head of the radius articulating with humerus and ulna. Just distal to the head of the radius is a narrowing of the bone known as the neck of the radius and on the antero-medial aspect is the radial tuberosity.

Lateral view in flexion

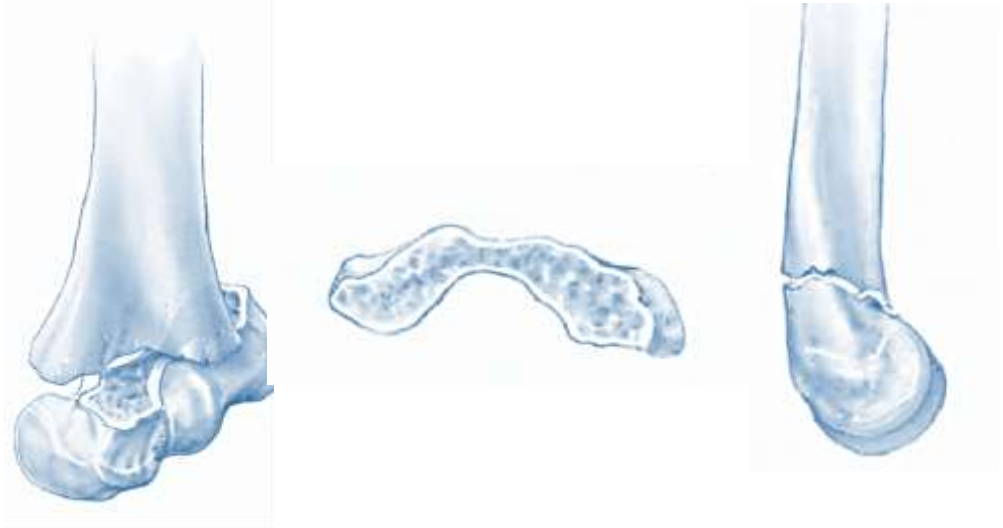
Medial view in flexion

The radio-humeral joint between capitulum of humerus and the head of the radius allows pronation and supination of forearm while the ulno-humeral a synovial hinge joint with articulating between the trochlea of the humerus and the ulna joint allows flexion and extension movement .

A synovial pivot type of joint articulating the head of the radius with the radial notch of the ulna constitutes the third articulation .These articulations are in turn attached to the humeral shaft via medial and lateral columns.

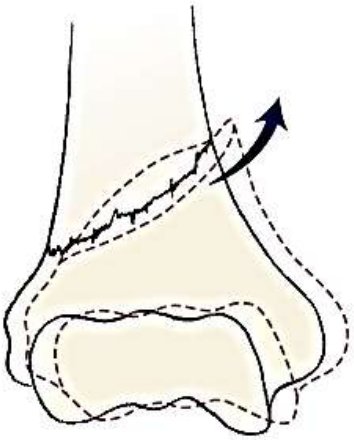
In the anatomic position, the long axis of the forearm creates a valgus carrying angle of about 10 -15 degrees to the long axis of the arm.

A thin part of bone is present between the two columns medial and lateral, comprising of coronoid fossa and olecranon fossa anteriorly and posteriorly respectively.



The weak point in distal humerus is this thin area where fracture begins . During hyperextension as in a fall ,the olecranon behaves as a fulcrum by which the force propagates as a fracture into both columns beginning in coronoid fossa.

These fractures are mostly at the level of olecranon fossa and are transverse in nature while Oblique fractures are commonly seen in older children .



This is important as rotation in oblique fractures will cause the distal fragment to angulate.

Although fracture occurs due to peculiar bony anatomy, the soft tissue around elbow has a potential for complications as well which are more common than the bony ones.

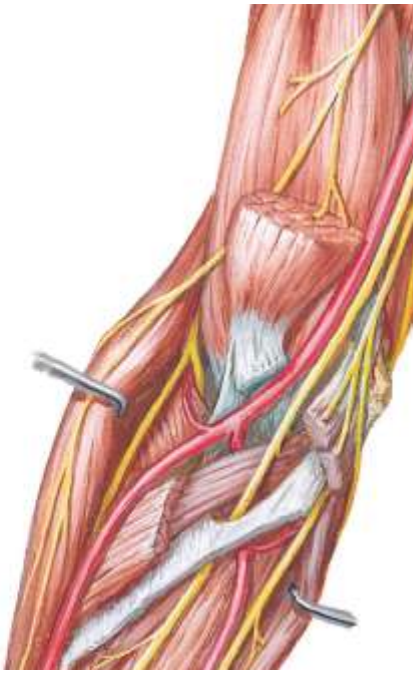
Muscles-

The elbow flexion normally ranges from 0-150 degrees and extension to 0-5 degrees in the neutral position. The biceps brachii, brachioradialis, brachialis, , and pronator teres flex the elbow while the triceps brachii and anconeus extend the elbow joint.

The supinator and biceps brachii supinate the forearm at the elbow while the pronator teres and pronator quadratus pronate the forearm.

Nerve supply-

The elbow joint are served by the radial, musculocutaneous and the ulnar nerves. Antero- lateral and posterolateral aspect of the elbow joint is supplied by C6 dermatome; the antero medially by the C5 and T1 dermatomes and the medial and posteromedial aspect by the C8 dermatome. Posteriorly on the middle portion by the C7 dermatome.

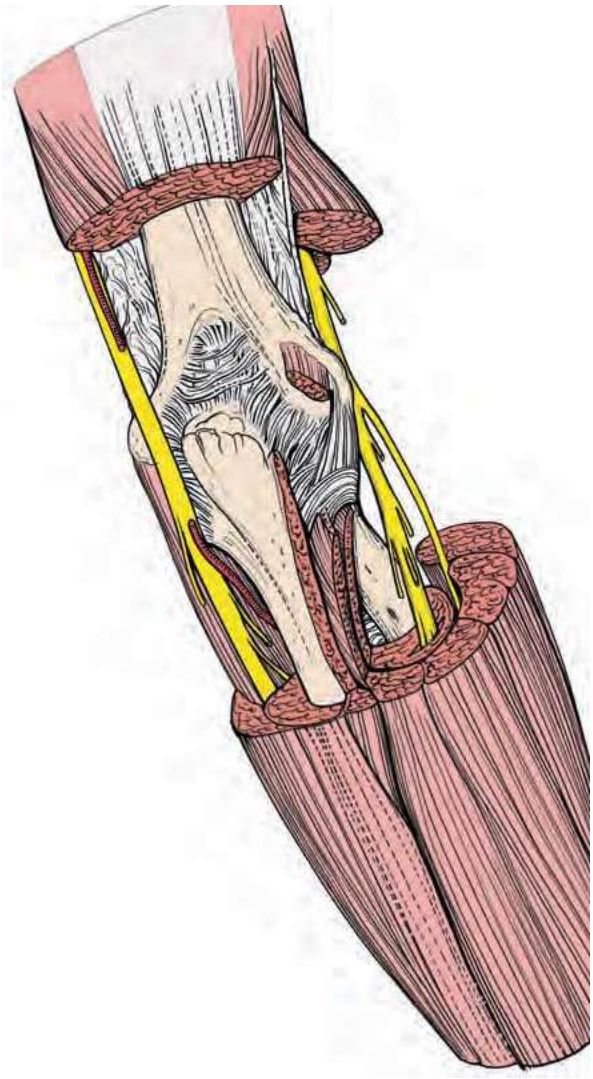


Anterior aspect elbow showing vital neurovascular brachial artery , median nerve and radial nerve along with muscle crossing elbow joint .

Laterally , inferior lateral cutaneous nerve of the arm and posterior cutaneous nerve of the forearm are the sensory nerves. Medially, the cutaneous nerve of the forearm supplies sensory nerves

The anterior aspect of the elbow is supplied by the lateral cutaneous nerve of the forearm a branch of musculocutaneous nerve.

Crossing the elbow joint anteriorly is the median nerve. Posteriorly, the ulnar nerve run along the cubital tunnel on the posterior aspect of medial epicondyle it then gives off branches to the flexor carpi ulnaris and the medial half of the flexor digitorum profundus just after crossing the joint .



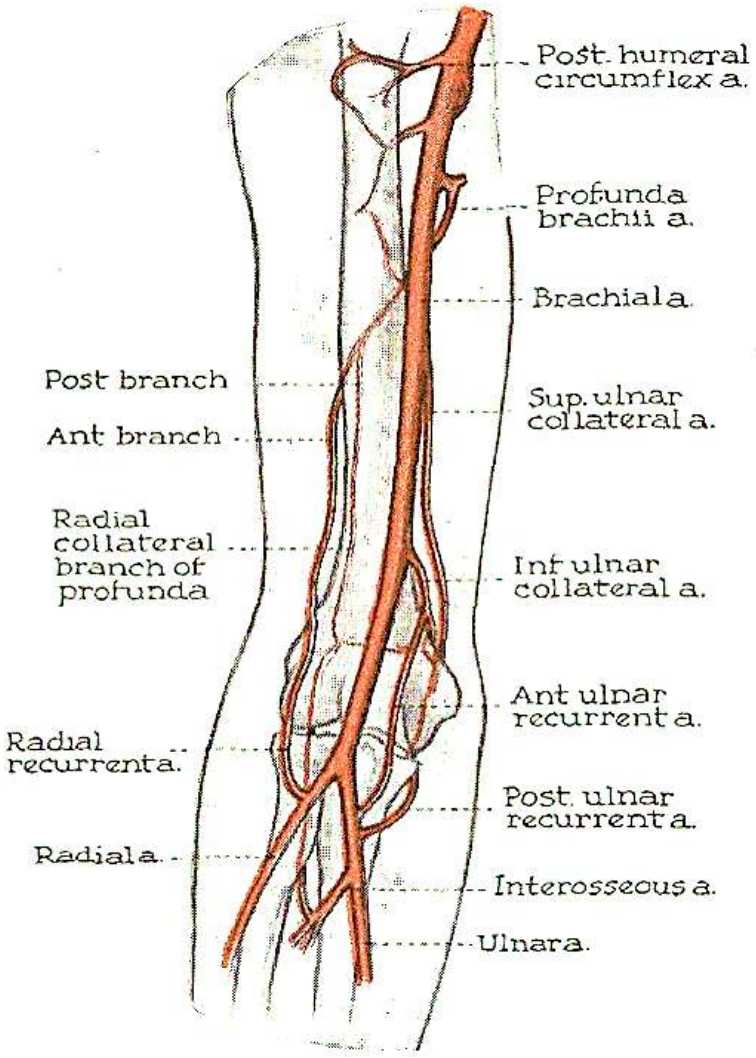
Posterior aspect elbow showing ulnar nerve and radial nerve relative to bony anatomy.

The radial nerve as it leaves the radial groove laterally in the arm gives branches to the brachioradialis and the extensor carpi radialis longus before dividing into the superficial and deep branches above the elbow joint , it then crosses anterior to the elbow joint as the superficial branch of the radial nerve which is primarily a sensory branch and the deep branch which innervates the extensor carpi radialis brevis .It continues into the forearm on the posterior aspect as

posterior interosseous nerve after innervating and piercing the supinator muscle.

The articulations of the elbow joint receive blood supply from the periarticular arterial anastomoses around the elbow. The brachial artery gives off the

1) superior and inferior ulnar collateral arteries 2) the deep artery of the arm which divides into the radial collateral and middle collateral arteries and then crosses the elbow joint on the anterior aspect medial to biceps tendon in the cubital fossa, it then divides into ulnar and radial arteries.

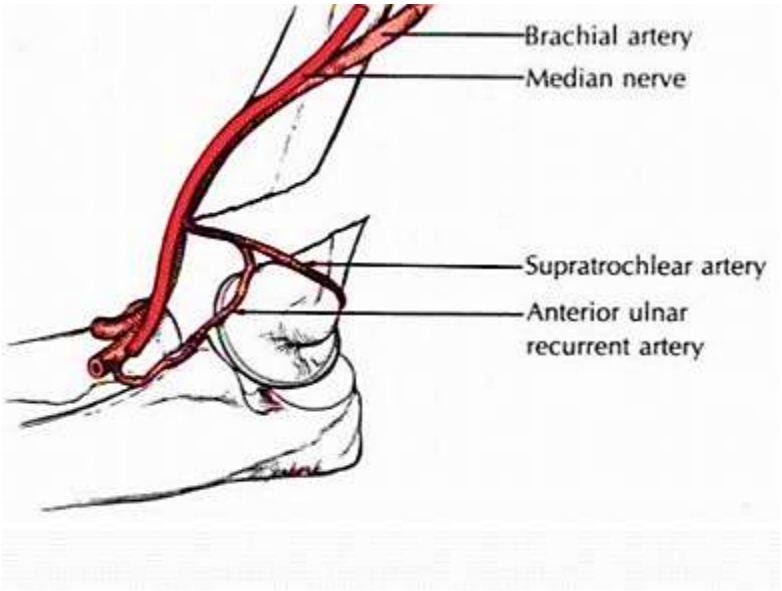


The ulnar artery gives rise to the anterior ulnar recurrent artery and posterior ulnar recurrent artery, the anterior ulnar recurrent joins the inferior ulnar collateral anterior to the medial epicondyle of the humerus, and the posterior ulnar recurrent artery anastomoses with the superior ulnar collateral artery posterior to the medial humeral epicondyle.

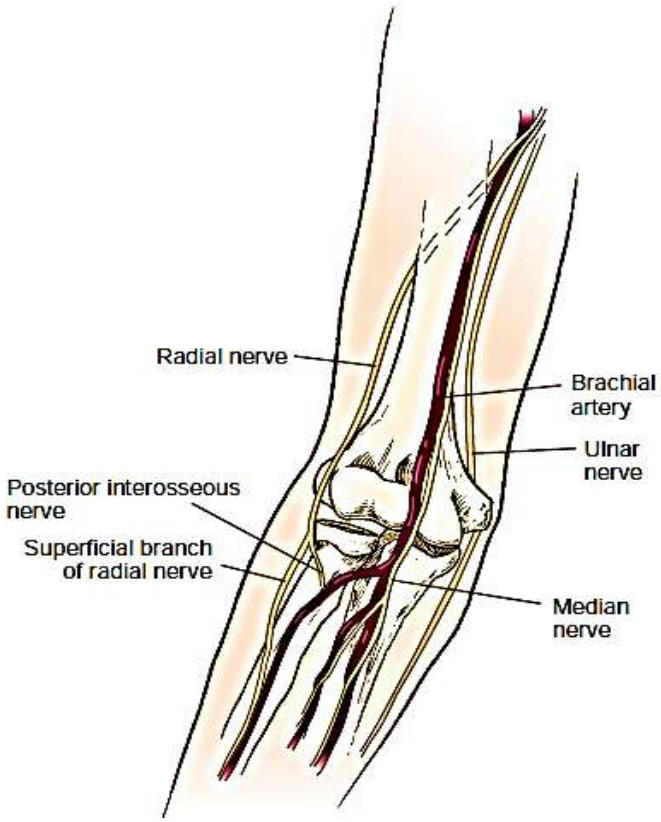
The radial artery gives off the radial recurrent artery anastomosing with the radial recurrent branch of the deep artery of the arm anterior to the lateral epicondyle.

The middle collateral branch of the deep artery of the arm divides posteriorly into two branches one of which passes inferiorly across the elbow to anastomose with the recurrent interosseous artery of the ulnar artery while the other joins the posterior ulnar and superior ulnar arterial anastomoses.

The supra trochlear branch of the anterior ulnar recurrent artery may hitch the main brachial artery against sharp end of the proximal fragment of a supracondylar humerus fracture.



In extension supracondylar injuries the proximal fragment may pierce the brachialis muscle, vessels or median nerve become entrapped between the fracture fragments and get compressed.



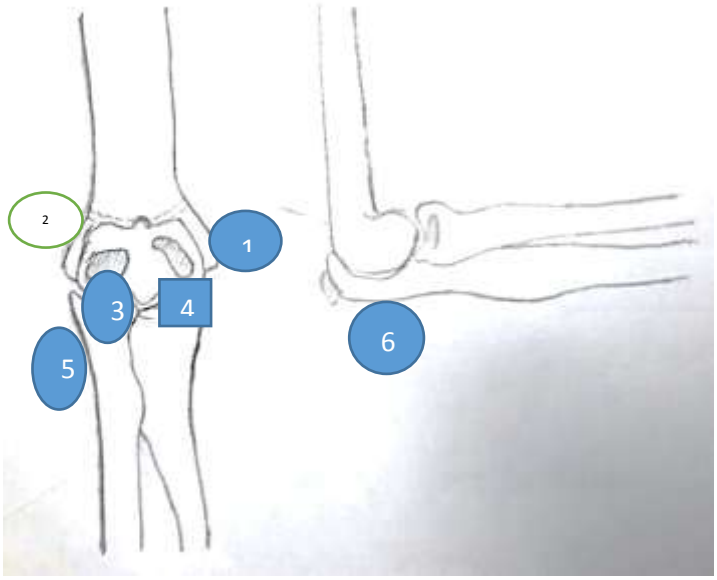
Among the soft tissue anatomy vital structures like median nerve and brachial artery pass anterior in the antecubital fossa. The ulnar nerve passes behind the medial epicondyle. The radial nerve enters anterior compartment of arm from the posterior compartment by piercing the lateral intermuscular septum roughly around the level of the olecranon fossa.

Also a neurovascular injury can occur indirectly from the stretching due severely displaced fragment and even hematomas can spread into the antecubital fossa beneath the fascia and has the potential to compress the vital neurovascular structures.

The pattern of displacement can also predict the vital structure prone for injury like the radial nerve is prone to injury by an anterolaterally displaced proximal fragment.

With the uncommon flexion injuries where the distal fragment is displaced anterior the ulnar nerve is at risk when it can tent over its posterior margin.

Two normal anatomic variants have been described one with no bone in olecranon fossa other with a supracondylar process which is a common site for median nerve compression . The ossification centers around elbow form in pre-set order.



1) Medial epicondyle

2) Lateral epicondyle

3) Capitellum

4) Trochlea

5) Radial head

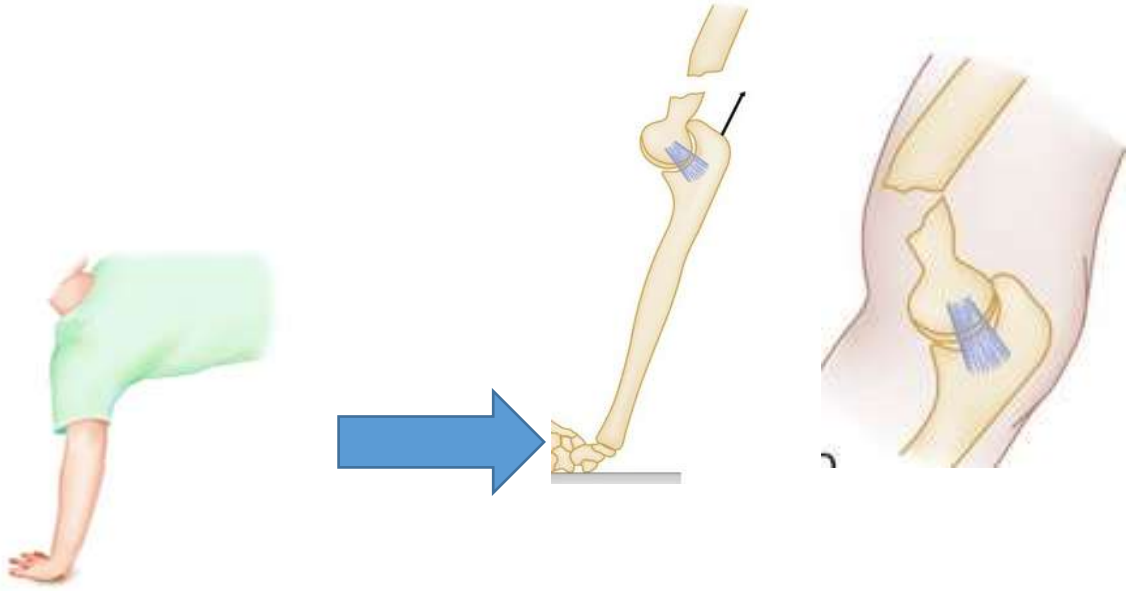
6) Olecranon

Mechanism of Injury

Force involved with these supracondylar fractures can be an extension or flexion force .

Commonly in play ground injuries the child tries to break the fall by the outstretching the upper limb which causes hyperextension at elbow joint which pushes the olecranon forcefully into its fossa while acting as a fulcrum , on the other hand anterior capsule creates a tensile force which cumulate to create an extension type of supracondylar fracture which is more common and seen in more than ninety five percent of the cases ,the distal fragment tends to displace

in posterior direction .



The other rare Flexion type fractures occur in upto 5% cases where a direct blow from the posterior while the elbow is in flexed position tends to displace the distal fragment anteriorly.

REVIEW OF LITERATURE

Prasanta Kumar Saha et al did a study with the aim to compare the results by two different modalities of pinning. The study was done over a period of 1½ year. 85 Patients are followed up for a period of 12 months. The conclusion is that close reduction and percutaneous fixation techniques are the standard methods by providing rigid stability and good union rate. Dorgan's lateral cross-wiring technique has the advantage of both-stability of cross wire fixation and avoiding the ulnar nerve injury. Although the results are not statistically significant [1].

Mehmet A. et al *was done* to evaluate the outcomes of traditional medial-lateral and Dorgan's lateral cross-wiring of supracondylar humerus fractures in children. They evaluated 51 children Group 1 (traditional) included 25 (16 male and 9 female, mean age 6.5 years) and group 2 (Dorgan's lateral) included 26 (19 male and 7 female, mean age 7.1 years) patients. Functional and cosmetic results were evaluated according to Flynn et al's criteria. Preoperative and postoperative neurologic examination was performed. The mean follow-up periods were 18.4 months in group 1 and 16.3 months in group 2. Postoperative iatrogenic ulnar nerve injuries occurred in 2 (8%) patients treated with the traditional medial-lateral (group 1) cross-wiring technique there were no other statistically significant difference they recommend Dorgan's lateral crosswiring

technique as it is as effective as the traditional medial-lateral cross-wiring technique, and prevents iatrogenic ulnar nerve injuries [7].

Abdul Latif Sami et al The objective of this study was to compare the incidence of iatrogenic ulnar nerve injuries in two different techniques of cross Kirschner wire configuration for the fixation of paediatric supracondylar fractures of humerus. Forty patients included in the study they found that fracture was fixed with two lateral cross Kirschner wire configuration none of the patients had iatrogenic ulnar nerve injury. In group B, (5%) patient in which fracture was fixed with mediolateral cross Kirschner wire configuration had an iatrogenic ulnar nerve injury [11]

Oliver Eberhardt et al with the aim of the study was to prove our method retrospectively to show the advantage of lateral cross-pinning achieving stability and avoiding ulnar nerve injury. 84 supracondylar fractures were included in the study. None of the patients exhibited secondary dislocation or iatrogenic ulnar palsies. Concluded as the method gives stability and avoids iatrogenic ulnar nerve injuries [7].

Sinisa Ducic et al to evaluate the non-standard Dorgan's method and compare its results with those of the standard percutaneous cross pinning prospective evaluation of 138 cases . In those treated by Dorgan's method neurological complications were not observed. They concluded that two laterally inserted crossed pins provide adequate stability with good functional and cosmetic

outcome for most unstable paediatric supracondylar humeral fractures with no risk of iatrogenic ulnar nerve injury [5].

Mohamad Osman et al aim of this study was to study the results of a cross-wiring technique, achieved solely from the lateral side, in an effort to reduce the risk of ulnar nerve injury. Thirty-two cases of displaced supracondylar humeral fractures were treated by the closed reduction and lateral cross-pinning technique. Functionally, 87.5% of the cases achieved satisfactory results and 12.5% achieved unsatisfactory results There were no iatrogenic nerve injuries. The lateral cross-pinning technique offers fracture stability and ulnar nerve safety. It could be considered as a viable option for treating displaced supracondylar fractures in children [3].

Umile Giuseppe Longo et al conducted a study to evaluate various rating systems for elbow, Eighteen scoring systems are currently available for the evaluation of elbow disorders. Each of them evaluates the elbow performance using specific variables, including both objective and subjective criteria. All these scoring systems were evaluated for reliability, validity and sensitivity [9].

Cekanauskas Emilis,et al conducted a study to evaluate functional, radiological, cosmetic results and incidence of iatrogenic neurological complications in children with supracondylar fracture: modified Dorgan technique The patients were divided in two groups (40 each), according to applied surgical technique (MDT vs. Cross pinning). recommend modified

Dorgan technique for the treatment of the children with supracondylar fractures, which is less complicated technically than traditional cross pinning and is as safe as Dorgan technique, maintaining biomechanical stability of fragments [4].

Bloom, MD* et al conducted a study which evaluates the relationship of the radial nerve to the distal humerus in a paediatric population on conventional MRI and proposes an anatomic safe zone using easily identifiable bony landmarks on an AP elbow radiograph they reviewed 23 elbow radiographs and MRIs of 22 children (mean age, 9 ± 4 years; range, 3–12 years) [2].

Mehmet A. Altay, et al conducted a study to evaluate the outcomes of traditional medial-lateral and Dorgan's lateral cross-wiring of supracondylar humerus fractures in children they evaluated 51 children with mean follow-up periods were 18.4 months There were no statistically significant differences found between the groups for gender, age, follow-up periods, fracture types, neurological or function, and cosmetic results. Although postoperative iatrogenic ulnar nerve injuries occurred in 2 (8%) patients treated with the traditional medial-lateral (group 1) cross-wiring technique, no nerve injury occurred in the Dorgan's lateral group(group 2) [6]

.Text books Rockwood and greens 7th Edition ,Tachdjian 2014 volume , Campbell 13 th edition .

CLASSIFICATION

Gartland's -

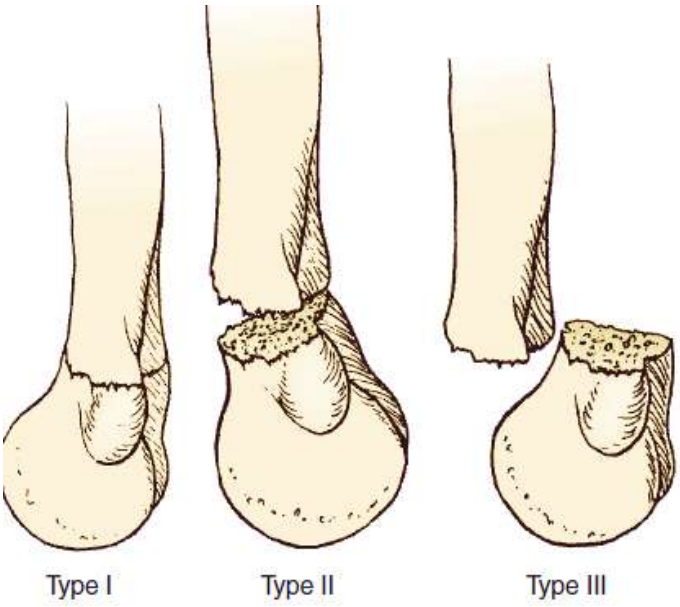
Supracondylar fractures of the humerus can be classified in a simple form into extension or flexion type based on the displacement of distal part of fracture on radiographs.

Classification system given by Gartland is still in common practice till date .

Type I fractures are nondisplaced or are minimally displaced.

Type II are those with one cortex remaining intact and some degree of anteroposterior angulation

Type III fractures are completely displaced with both cortices fractured and with a rotational component.



Type I Gartland's with sail sign

Type II gartland's

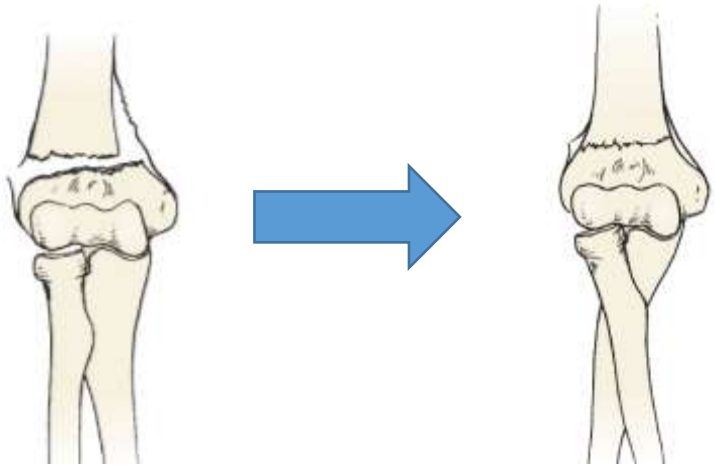
Type III Gartland's

Modifications of this classification include ;

Subdivision by wilkins into type III gartland based on the displacement of distal fragment to identify the complications and reduction manoeuvres from the injury and problems during reduction .

Posterolateral displacement

A Posterolaterally displaced distal fragments are more commonly associated with neurovascular injuries and also the distal fragment displacement predicts periosteal sleeve intactness it is usually intact on the side to which the distal fragment is displaced. This periosteal sleeve helps stabilize the fracture when it is reduced hence Pronation tightens the medial sleeve and supination tightens the lateral sleeve.



Pronation

- A type IV gartland had been described where the fracture is highly unstable due to lack of posterior periosteal hinge.

  Another modification is from **Mubarak and Davids** where they divided type I fractures into IA and IB.

Type IA injuries are nondisplaced simple fractures without comminution.

Type IB fractures have characteristic comminution in the medial column

So these type Ib if unreduced could lead to a bad outcome from unpredicted loss of reduction during follow up period .

Other classification systems for this fracture include arbeitsgemeinschaft fur osteosynthesefragen pediatric comprehensive classification which takes the degree of displacement into consideration the calssificatio is as follows No displacement as level 1 , one plane displacement as level 2 , rotation of distal fragment as level 3 , rotation with displacement in all three planes as level 4.

DIAGNOSIS

Supracondylar fractures are often easily diagnosed even by just inspection or in some cases can be difficult to diagnose even with radiographs .

The clinical examination is of utmost importance remembering to perform a thorough examination to assess for associated injuries and possible neurologic injury which is seen in 10% to 15% of fractures .

Although a complete neurologic examination is not always possible especially very young children and uncooperative children , it is easy to assess the vascular status and especially important in displaced supracondylar humeral fractures.

A compartment syndrome should always be kept in mind while dealing with these fractures with the early sign being pain out of proportion to physical findings and is more persistent than with just fracture alone other signs like tense compartment of the limb ,pain with passive fingers extension can also be elicited. The descriptive triad of pallor, paralysis and paraesthesia develop late and by then irreversible soft tissue damage would have occurred.

The ipsilateral fractures usually that of distal radius fractures occur in up to 5%.

The differential diagnosis of severely displaced supracondylar fractures include elbow dislocation common in elder children, transphyseal injuries common in younger and lateral condyle fractures easily differentiated by

radiographs . Also the history gives clue about other diagnosis such as septic arthritis where onset of pain is not immediately after injury and a has a lag period.

Supracondylar fractures usually begin at olecranon fossa and they are transverse or short oblique especially children of older age group.

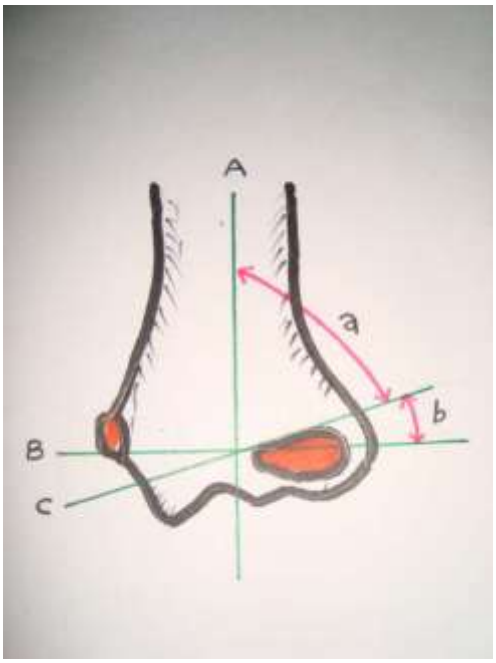
The diagnosis of a minimally displaced supracondylar humeral fracture can be difficult sometimes with early presentation where very less swelling may be seen .

Clinical examination will reveal mild swelling and tenderness over supracondylar ridges.The diagnosis should be confirmed radiographically but often difficult to obtain true views due to painful limb and also in more displaced fractures which is less of a problem in minimal or moderate displaced fractures.

Also oblique views may be useful if fracture line difficult to visualize in AP and lateral views.

While Radiographic parameters observed on *an AP radiograph* of the distal humerus are ;

-*Baumann's angle* between the physeal line of lateral condyle and a line perpendicular to long axis of humerus. The normal angle varies between 8 to 28 degrees.



-Assessment for comminution of the medial and lateral column and if there is any translation.

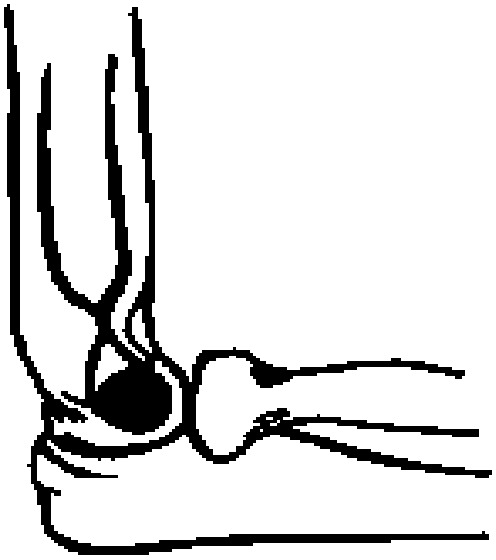
Radiographic parameters on the *Lateral radiograph* are

-*The fat pad anterior sign* due to effusion within the elbow which creates the wide triangular radiolucency anterior to the distal humerus .The posterior fat pad similarly if an effusion is present will be visible posteriorly although difficult to visualize since the elbow is kept flexed.

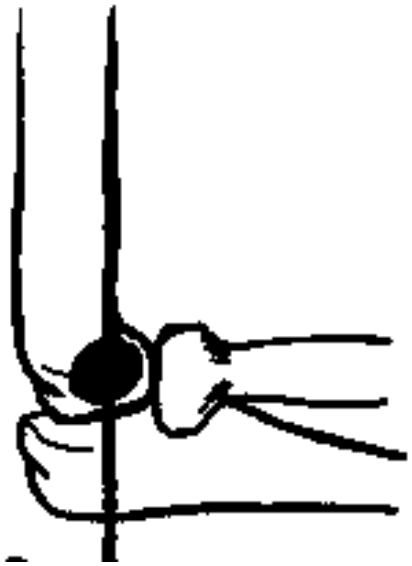
NORMAL FAT PADS

WITH EFFUSION

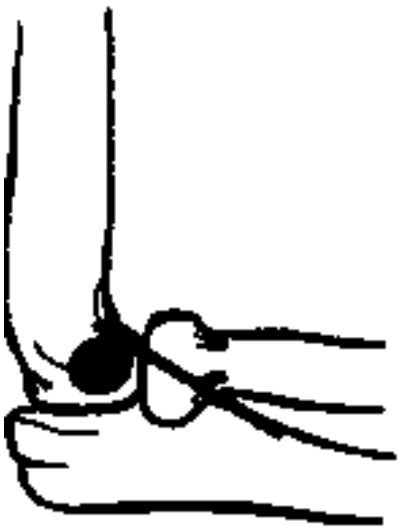
Teardrop or hourglass formed by distal humerus to determine radiographic technique.The distal part of which is formed by ossification center of the capitellum should appear as a perfect circle.



Obscured teardrop or hourglass is due to fracture displacement or a oblique radiograph. The anterior part of Tear drop normally represents fossa of coronoid and the posterior part represents the fossa of olecranon the inferior aspect is the capitellum .



-The anterior humeral line which is drawn through the anterior cortex humerus should bisect the middle third capitulum. This line denotes the normal alignment of the elbow . in some children especially younger than four years old this line tends to bisect across the anterior third in which case other signs of trauma need to be checked .



-The coronoid line, a line drawn along anterior border of the coronoid process, should just touch the anterior border of capitulum.

TREATMENT

These fractures in children should be treated with utmost care bearing the acute and chronic complication in mind

At presentation

Limb should be immediately immobilized in presenting position by a simple splint. Care should be taken while taking x-rays such that the splint should not distort radiograph shadows.

Attempt to align the fracture fragments to be made immediately in the emergency department if signs of ischemia seen with severe displacement which immediately restores circulation to the hand.The pulse should be evaluated before and after the splint is applied.

Open fractures require a copius irrigation of wound preferably by Ringers lactate solution and should receive intravenous antibiotics and tetanus prophylaxis if indicated and should be kept nil per oral till management has been planned.

Treatment of Nondisplaced Fractures

Consists mainly of an above elbow cast immobilization for 3 weeks with the forearm in neutral position and elbow flexion not more than 90 degrees. Follow up after 7-10 days is done to check for any loss of reduction on radiographs ,

after which above elbow cast for another 2-3 weeks is applied. After cast removal the arm is protected by sling for further 2 weeks . After which active mobilization is started during the management by cast. Risk of

compartment syndrome should be explained to caregivers and that at subtle signs of increased swelling and pressure consultation should be done immediately also important is not to immobilize the arm in more than 90 degrees and to keep elbow above the level of heart for the first 2 days after injury.

Treatment of Displaced Fractures

These fractures require reduction. Most of the cases reduction can be accomplished in a closed fashion. Gold standard in managing these displaced fractures is a good reduction and pinning . Inability to achieve a closed reduction calls for an open reduction .

Closed Reduction

Extension Type

Under general anaesthesia, the child is positioned at the edge of the table, with the arm over a radiolucent table to allow image intensifier to work.

A steady traction to be placed on the distal fragment in full extension ,this traction is sustained while coronal plane deformities like Varus and valgus are corrected.

Now the fingers of the dominant hand apply a posterior force to the proximal fragment. While the thumb of the dominant hand is advanced along the posterior humeral shaft, when the thumb reaches the olecranon an anterior force to the distal fragment is given .

The elbow is flexed after this along with pronation or supination according to the displacement of the distal fragment and the elbow hyperflexed to lock the reduction

Image intensifier is used to confirm the reduction . Once the reduction has been confirmed the immobilization can be with a cast, traction, or pin fixation

- *Posterolaterally* displaced fracture reduction is difficult because supination is not very effective at tightening the lateral sleeve of soft tissue hinge unlike pronation in posteromedial displacement, and during hyperflexion, these fractures occasionally displace into valgus. In these cases the elbow is flexed and a varus force is applied while flexion is done only upto 90 degrees.

- Always avoid vigorous manipulations and remanipulations as they cause more swelling.

Flexion Type

Similar to previously described manoeuvre longitudinal traction and the elbow in extension the distal fragment is reduced by a posteriorly directed force.

-Valgus and varus are then corrected followed usually with percutaneous pinning.

Percutaneous Pinning.

Percutaneous pin fixation yields a better predictable result when dealing with paediatric supracondylar fractures

The technique for percutaneous pinning involves the placement of two or three 1.8 mm smooth K-wires. The controversies in k wire fixation exist between 2 or 3 wires and crossed vs parallel lateral only wiring.

Most commonly after locking the reduction with the assistant holding the reduction the surgeon places the lateral wires, first from distal to proximal.

If two lateral pins are planned the first wire is placed as medial as possible so that the second pin can be placed at a relatively lateral distance such that while crossing the fracture site the pins are maximally separated so as to ensure stability this is especially important while using lateral only wires.

Next ,the medial pin is inserted in inferior most aspect of the medial epicondyle care should be taken to prevent iatrogenic ulnar nerve injury .

There are several techniques to prevent ulnar nerve injury

1) Mini open technique using a small incision

2) Slightly extending the elbow so that the nerve subluxates posteriorly

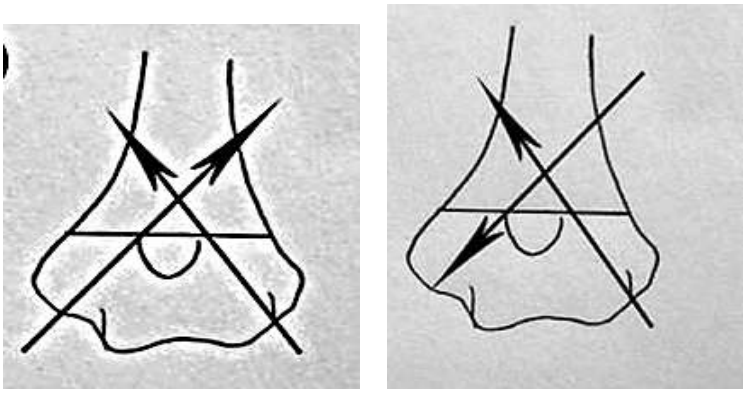
3) Using a sleeve

4) To milk the soft tissue posteriorly

It is usually not the direct impalement which causes nerve injury but the soft tissue tethering while insertion , heat during insertion and nerve tenting against k wire while flexing the elbow for plaster immobilization during post-operative period that cause palsies. It is the least commonly injured nerve by supracondylar fracture itself and it occurs mostly in rare flexion type fractures. It is the most commonly injured nerve by surgical technique.

The pin should be started as far anteriorly as possible and directed 20-30 degrees in the posterior direction since the distal humerus portion is angled in an anterior direction relative to the shaft portion.

Once the fracture has been stabilized the reduction and pin placement are confirmed on orthogonal radiographic views . If acceptable, the pins are bent and cut for purpose of removal and covered by a gauze to decrease pressure and skin motion surrounding the pin. The arm is the immobilized in 30 to 60 degrees of flexion in a posterior slab which is converted to cast during follow up.



Observation can be done for 24 hrs for development of early complications and discharged if satisfactory .The child usually returns in 7 to 10 days for clinical check-up and x-rays are repeated to check for maintenance of reduction.

At 3 weeks follow up the radiographs are repeated, the pins and cast are removed. The child is then placed in a cuff and collar for further two more weeks after which only active Range of motion exercises are started. Caregivers are instructed strictly to avoid forced manipulation.

Final follow-up at 6 to 8 week to evaluated fracture alignment and elbow range of motion. Complications with percutaneous pinning, including *pin tract infections , iatrogenic ulnar nerve injury and loss of reduction*.

-*Pin tract infections* are seen in 2% to 3% of patients these infections usually respond to removal of the pin and oral antibiotics.

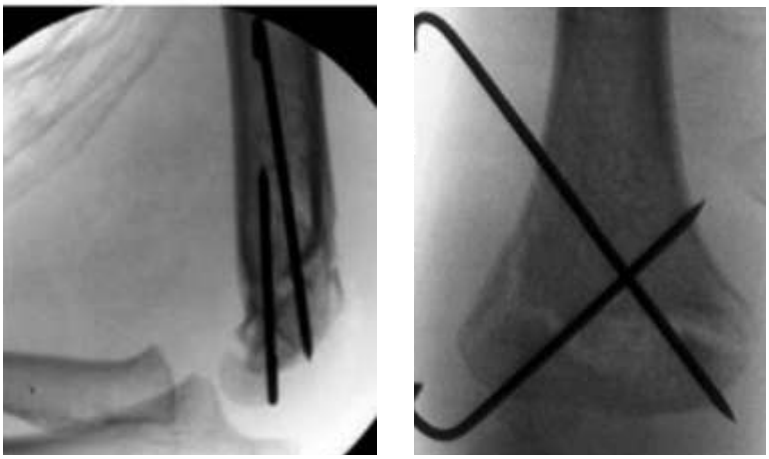
-*Ulnar nerve injury* from a medially placed percutaneous pin is another complication which is seen in up to 10 -15 % cases. If a deficit is noted postoperatively of ulnar nerve the removal of medial pin can be done and observed for recovery which in most cases makes a complete recovery.

-*Loss of reduction* can occur after pinning of supracondylar humeral fractures .This complication is mostly due to poor surgical technique and it is imperative to follow general principle in pin fixation like maximal pin separation at fracture site and adequate purchase in both fragments.

Dorgan's technique of lateral crossed pinning :

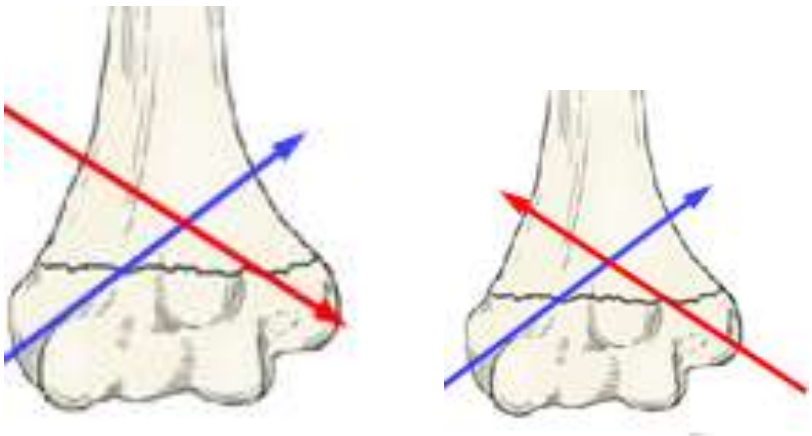
In this technique the usual lateral column k wires are passed after satisfactory closed or open reduction after which the medial column pin is passed from lateral to medial in an anterograde direction , this pin should not penetrate the medial cortex it acts as an anti rotation supplement.

other general principles of pin fixation should be followed like Pin Purchase of two columns sufficient bone engaged in the proximal and distal fragments maximally separate the pins at the fracture site two pins for Gartland-type II fractures, and three pins for Gartland-type Ill fractures

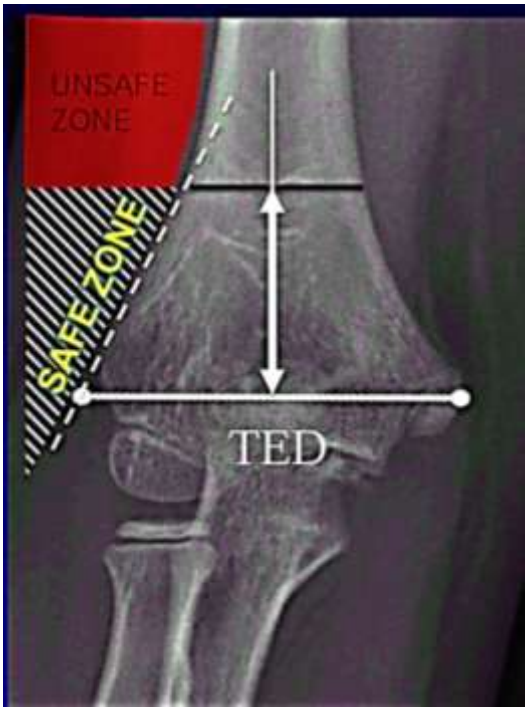


In crossed pins ideally crossing should be above fracture line and in the mid 3rd of humeral shaft.

There is a theoretical risk of injury to radial nerve injury while placing the lateral wire anterograde into the medial column . It is ideal to take entry at a point distal to an imaginary line which is equal to roughly the inter epicondylar distance from the lateral epicondyle which is the safe zone as radial nerve enters anterior compartment of arm at this level.. Other way is to begin distal to supracondylar flare origin seen on fluoroscopy. Also the entry is slightly posterior to the mid coronal plane .



After pinning reduction once again is confirmed with elbow slightly extended and pins are bent and cut short with adequate padding to avoid pressure sores after which an above elbow slab is applied . The post operative protocol is similar to traditional crossed pinning technique where examination is done at 7 -10 days to check for any pin tract infection or in case of open reduction suture removal and wound care and a cast conversion is done after which child is reviewed after 3 weeks when a check radiograph of elbow is obtained to look for any loss of reduction if healing and reduction look satisfactory cast and pins are removed and an arm sling is put for further 2 weeks . after the 2 weeks of protection by arm sling elbow is mobilized actively as tolerated . Further follow-up is done to check for regain of range of motion and any intermediate or delayed complications.



CAST IMMOBILIZATION

The second method of immobilisation advocated by some surgeons due to the ease of procedure and reduced iatrogenic complications . It has some well-known complications mainly *loss of reduction and ischaemic contractures.*

-*Loss of reduction* is unfortunately discovered at 3-4 weeks follow-up only when slab is removed and extension is achieved.

- *Ischaemic contractures* due to Volkmann's ischaemia occur as a result of flexion in cast. A frame cast can be used with a recess in the antecubital fossa and adequate oedema control management to be taken up to avoid such complication.

Despite all these efforts unpredictability factor has put percutaneous pinning technique gold standard for displaced supracondylar fractures children

Traction

This modality in management of supracondylar humerus fractures is obsolete now a days

Open Reduction

Indications:

1. Pale pulseless limb that does not improve after fracture reduction

2. Open fracture

3. Irreducibility

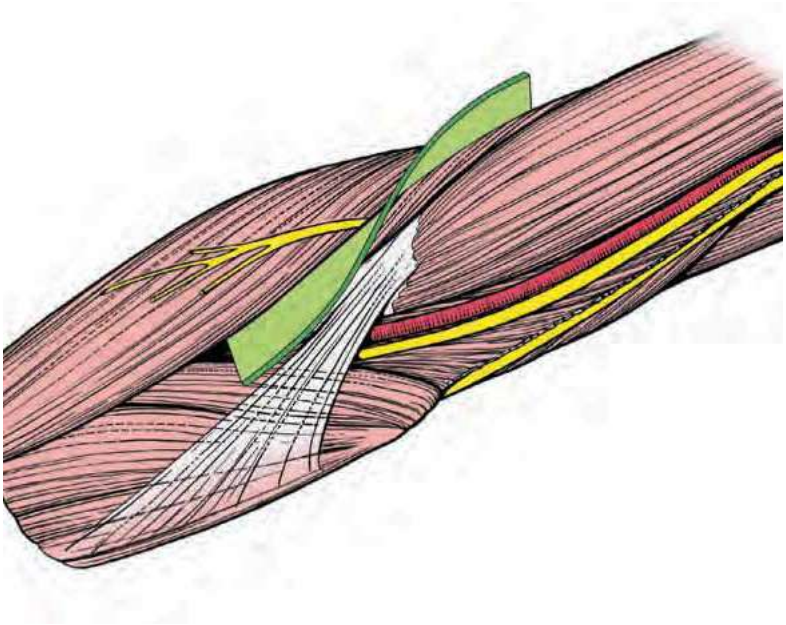
4. Unsatisfactory closed reduction.

1. - If the hand remains *ischemic* after reduction an immediate brachial artery exploration to be done by an anterior approach ,the fracture should be reduced and pinned percutaneously after which the vascular pathology is addressed by a vascular surgeon.

2. -*Open fractures* like anywhere in the body need emergency operative debridement. After which the fracture is reduced with an open technique and pining is done. With debridement, fracture stabilization and antibiotic coverage the complication in open fractures is similar to that of severely displaced closed fractures.

3. -Supracondylar fractures can sometimes be *irreducible* due to buttonholing into brachialis muscle it has a characteristic pucker sign clinically which should warn the surgeon to the need of an open reduction.

4. -A closed reduction with mild angulation in the sagittal plane and translation in the coronal plane, a mild amount of valgus angulation in the coronal plane is acceptable. But a *Varus angulation i*n the coronal plane especially if associated with a hyperextension deformity in the sagittal plane will result in a poor result that is difficult to remodel.



-Posterior triceps-sparing approach has a poor functional results, damages the intact periosteal hinge posteriorly and has bad cosmetic results .Hence an anterior approach is more logical. But in general to protect the intact periosteal hinge an anterior approach is considered for extension injuries while a posterior approach is used for flexion injuries.

In anterior approach a transverse incision is used directly over the antecubital fossa , a plane is developed between biceps and brachialis muscle , bicipital aponeurosis is released and brachioradialis is retracted laterally and bicep , brachialis is retracted medially . care should be taken to protect posterior interosseous artery and radial nerve . These open reduction are ideally performed after oedema subsides and not later than 5 days post injury as risk of myositis ossificans increases.

Management of Late-Presenting or Malreduced Fractures

Appropriate management of a patient who is initially evaluated 10 to 14 days after injury and found to have an unreduced or unacceptably reduced fracture is often difficult to plan.

Obviously the condition of the skin and neurovascular structures is an important factor to consider when determining treatment. Other factors include the age of the patient and the time since injury.

Some surgeons advocate a wait and see approach to these fractures because attempts at manipulation once early callus begins to form may not improve the reduction but increase stiffness.

Others attempt a closed or open reduction for these fracture presentations.

Unfortunately, there is little in the literature to guide the decision making process regarding these malreductions. Usually accept an adequate non-anatomic reduction rather than proceed to open reduction.

Complications

Complication can be Divided into early or late.

Early complications include

-Vascular injury,

- Nerve injuries and

-Volkmann's ischemia

Late complications include

-Malunion

- Stiffness and

-Myositis ossificans.

The anatomy and severity of injury in supracondylar humerus fractures of children make these complication common.

Vascular Injuries

The incidence has been reported to be up to 40%.It includes both direct and indirect injuries.

Direct injuries are those where the fracture fragments cause a injury commonly laceration or sometimes complete transection .indirect injuries are those with a compression type injury where displaced fracture fragments cause the vessel to kink. Immediate management would be to reduced the severely displaced fracture and reassess for pulse .if still pulseless open reduction and exploration can be attempted.

Spasm in the artery may be relieved by a local papaverine, stellate ganglion block, resection with a reverse interpositional vein grafting to bridge the gap. Vascular surgeon

is needed while deciding the appropriate management. It is important to perform a fasciotomy if limb has been ischaemic for a long time or when the compartment pressures measured are elevated. There are controversies in the management of ischaemic limb with supracondylar humerus fractures and the management options include observation, arteriography, and exploration. A conservative approach with observation commonly followed. The earliest sign of a vascular injury is a pulse difference when compared with opposite limb.

Peripheral Nerve Injuries

Nerve injury occurs in about 10% to 15% of supracondylar fractures.

Most common nerve injury in extension type fractures are *Anterior interosseous nerve injury* .In posterolateral displacement a medial nerve injury is more common and in a posteromedial displacement an injury to radial nerve injury is more common in flexion type injuries. The anterior interosseous nerve is frequently missed as it has no sensory distribution .

The Ulnar nerve injury can occur as a result of the fracture but the ulnar nerve is more commonly injured iatrogenically from medially placed pin.

Often difficult to perform a full neurologic examination in children especially young . Thus it is essential to counsel the parents that there is a chance that a nerve injury would be discovered as time progress and also such injuries spontaneously improve. Hence close monitoring for recovery and perhaps splinting or Range of motion exercises or

both, so that contractures do not occur. Most injuries recover fully. But if not recovering within 8 to 12 weeks nerve conduction and electromyographic studies should be done to confim if the nerve has not been transected. If found to be transected then grafting or tendon transfers can be done.

Volkmann's Ischemic Contracture

Richard von Volkmann described ischemic paralysis leading to contracture of muscles of forearm and hand and less often the leg after the application of tight bandage during the treatment of injuries in the elbow and knee joints. If increased risk for compartment syndrome then patient should be monitored carefully mainly in high energy trauma.

A supracondylar fracture associated with a compartment syndrome is treated by release of the compartment , adequate splint followed by range of motion exercises

Malunion: Cubitus Valgus and Varus

Cubitus varus and cubitus valgus are the most common complications of supracondylar humeral fractures. The incidence varies from 0% to 50%.

A posteromedially displacement fracture has a tendency to develop varus deformity while a posterolaterally displaced fracture tends to form a valgus deformity .Cubitus varus deformity is more clinically significant deformity compared to cubitus valgus. These deformities can develop due to disproportionate growth are more commonly result of malunion itself.

While measuring the carrying angle of the upper limb the elbow is extended and forearm is fully supinated and the medial border of forearm and medial border of the arm is identified and the angle subtended by them is taken as the carrying angle are present then a surgical correction may be warranted.

This carrying angle has a wide individual variation. So a comparison with the contralateral side is essential. Since these cubitus valgus and varus deformities are mostly cosmetic, mild degrees of malunion can be managed by a just reassurance. If the deformity is severe or functional limitations

The *Cubitus varus* deformity is a combination of Varus, internal rotation and an extension deformities . While the rotation deformity is tolerated well , surgical correction mainly concerns extension and Varus deformities also because rotation make the fragment unstable due to anatomy is distal Humerus of children.

-The operative techniques are medial and lateral closing wedge, step-cut, and dome osteotomies.

-Persistent deformity are the most common complications after osteotomy correction and often a residual rotational deformity is see in most of the cases after a correction .

-Elbows with deformities are more prone to functional limitation, recurring fractures, and bad cosmetics. Fortunately, functional problems are uncommon with either deformity. In cubitus valgus, functional problems may be related to a coexisting flexion contracture or, in extreme cases, to tardy ulnar nerve symptoms.

With *Cubitus varus*, functional problems are almost always related to limitation of flexion due to the hyperextension associated with varus malunion and with the arc of elbow motion remaining same. Tardy ulnar nerve palsy and instability have also been described. But cosmetic deformity is the most common problem with malunion

Commonly a lateral closing wedge osteotomy with just varus correction or sometimes the component of flexion if needed and fixation by cross pinning it is usually performed via a lateral approach and is technically simple.

Elbow Stiffness and Myositis Ossificans

-Assessment of elbow range of motion is usually done at 6 to 8 weeks when the cast has already been removed. It is uncommon for more than a 10- to 15-degree of flexion or extension stiffness but if stiffness more than this is seen then a physiotherapy with gentle range of motion exercises is begun. The progress is monitored using subsequent follow up. Stiffness requiring surgery and release is uncommon.

-Myositis ossificans is a very rare complication which often resolve in 1 to 2 years of time.

Part B

Materials and methods

Results

Illustrative cases

Discussion

Conclusion

MATERIAL AND METHODS

- Proposed study to be Conducted in Rajiv Gandhi Government General Hospital, Chennai during period of May 2015 – September 2017
- All patients admitted are resuscitated in trauma care and evaluated using trauma series radiographs if found necessary and with opposite normal side radiographs
- Fractures are classified clinically and using true anteroposterior and lateral radiographs of elbow with preoperative clinical examination is recorded.
- Fractures are selected for this pinning technique using inclusion and exclusion criteria

Patient's parents /guardian are counselled regarding advantages, disadvantages and possible complications of this procedure and a written consent is obtained .

- These patients were divided in group A and group B. Each group consisted of 10 patients. The fracture of patients in group A was fixed with two lateral cross Kirschner wires configuration and fracture of

patients in Group B was fixed with mediolateral cross Kirschner wires con-figuration. All the operations were performed by senior consultant orthopaedic surgeons. Technique of Kirschner wire fixation of the fracture was allocated to the patients randomly . The retrospectively studied cases were taken from our IOTRA wing (Institute of orthopaedics and Traumatology Research Analysis). The prospective cases were followed up using the same IOTRA where all the patient details are digitally stored using a software .

Inclusion criteria

- All displaced Supracondylar humerus fractures.
- Age <15 years
- No previous ipsilateral elbow injury

Exclusion criteria

- Age > 15 years
- associated neurovascular injuries

Functional classification-

- Flynns criteria is used to classify into **satisfactory or unsatisfactory**

- Range of motion ,carrying angle and presence of neurological deficits are measured.
- Rated as poor ,fair ,good and excellent.

Poor – unsatisfactory

Fair ,good and excellent being satisfactory.

RESULTS

In this study groups A and B could be compared with respect to fracture characteristics, post-reduction radiographs which shows satisfactory randomization. Included in this study are 20 patients who were operated for displaced type III supracondylar fracture of humerus.

-Among the 20 patients in this group the **average age group was 10 years** and with **male preponderance** and 18 patients were right dominant 2 were left dominant .All the fractures were of **type III gartlands** with 12 were left sided and 8 right sided fractures

The group A (lateral pinning group) comprised 10 patients. The mean age was

9.9 years. Among which 8 patients were males and 2 females. In 9 patients injury occurred due to fall from height, and 1 due to Road traffic accident. All were Right dominant . 4 patients had Right elbow and 6 had Left elbow fracture. In most of patients primary splintage was done. Displacement was posteromedial in 8 patients, 2 had posterolateral . 8 patients in this group had closed reduction and pinning while 1 had open reduction and pinning done. No Iatrogenic ulnar nerve injury was found in this group. The mean Baumann angle loss was 5±0.73. No

patients had post operative loss of reduction. Total range of motion was 132 degrees Flynn criteria satisfactory in 8 unsatisfactory in 2 patients. 2 patients

had superficial pin tract infection. 8 patients had full return to function and only 2 had minor limitation in daily activities..

The group B (traditional pinning group) comprised 10 patients. The mean age was 6.9 years. Among which 6 patients were males and 4 females. In 8 patients injury occurred due to fall from height, and 2 due to Road traffic accident. 7 were Right dominant while 2 were Left dominant . 6 patients had Right elbow and 4 had Left elbow fracture. In this group also most of patients had primary splintage . Displacement was posteromedial in 9 patients, 1 had

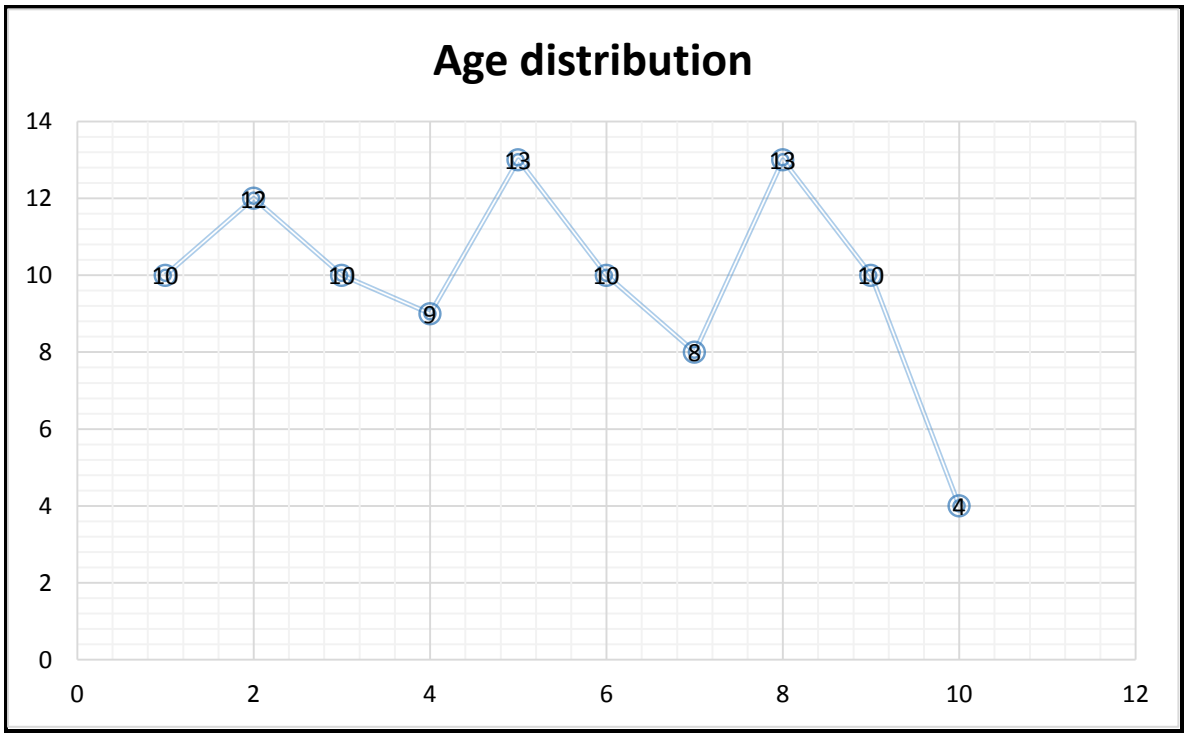
posterolateral . 9 patients in this group had closed reduction and pinning while 1 had open reduction and pinning done. 2 patients had Iatrogenic ulnar nerve injury was found in this group. The mean Baumann angle loss was 5±0.77. No patients had post operative loss of reduction. Total range of motion was 129.5 degrees Flynn criteria satisfactory in 8 unsatisfactory in 2. One patient had superficial pin tract infection. 8 patients had full return to function and only 2 had minor limitation in daily activities..

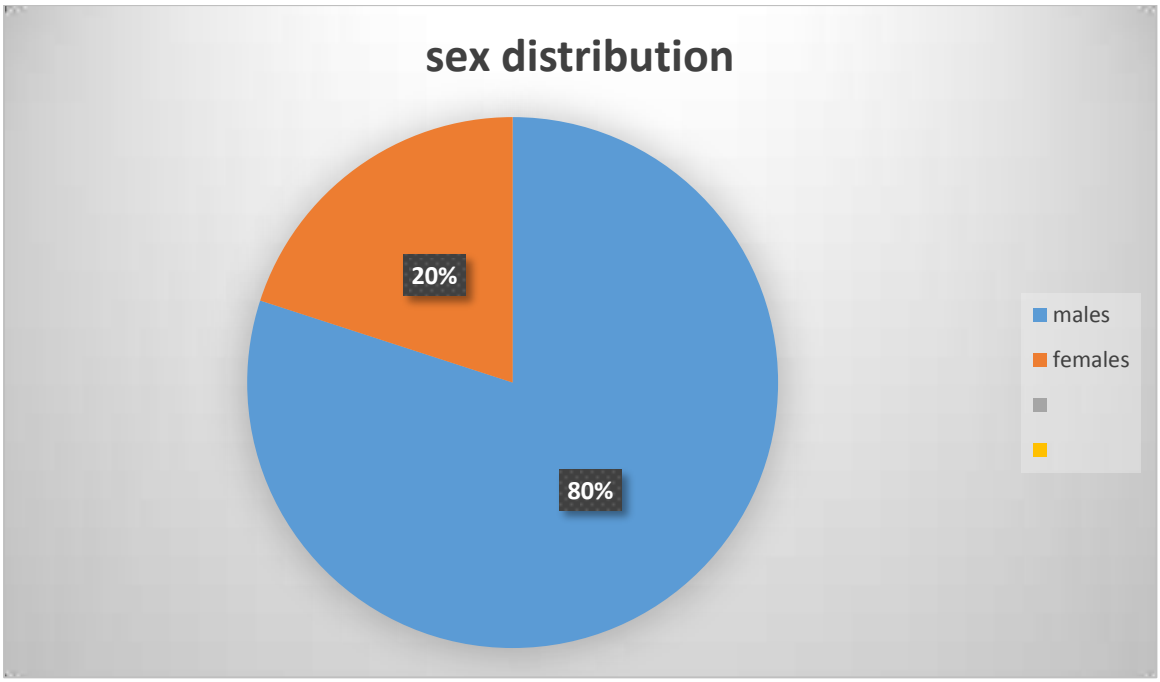
Both groups A and B were compared in terms of parameters given in the table below. **There were no significant differences (p> 0.05) between groups with regard to any of these variables except 2 cases in group B had Iatrogenic ulnar nerve palsy which needed pin removal which recovered subsequently.**

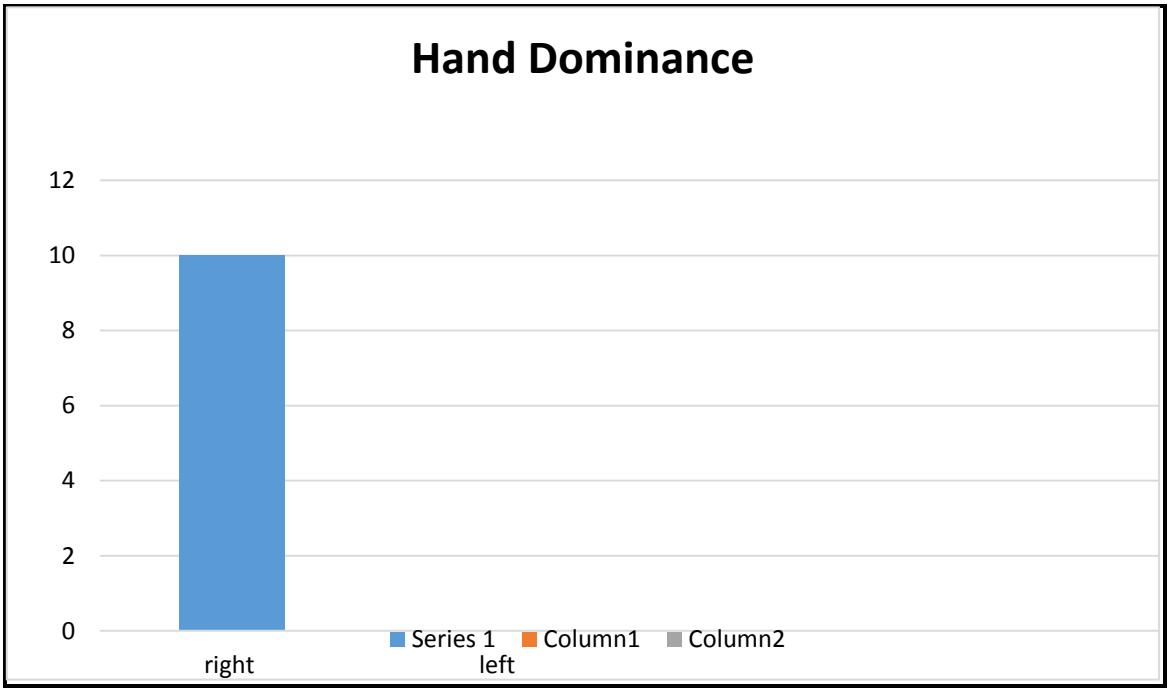
Parameters comparison Table-

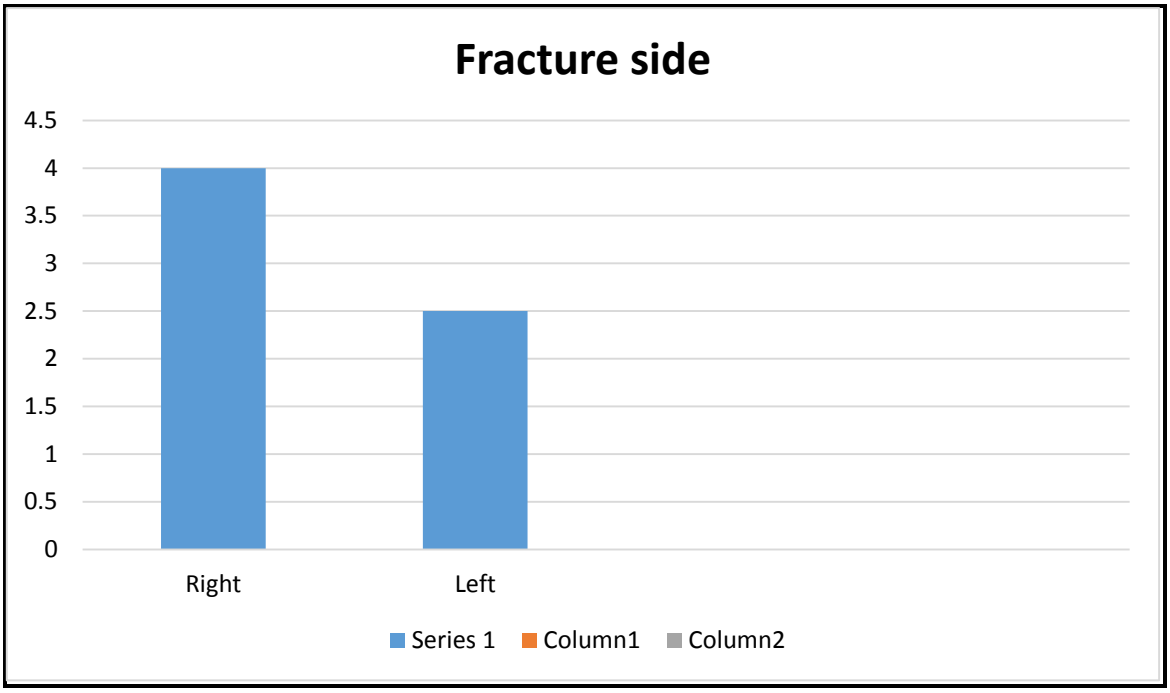
		GROUP A	GROUP B	t score	p-value
Age (yrs)*		9.9± 2.51	6.9±4.10	0.218	0.414
Sex	Male Female	8 2	6 4		0.144
Hand dominance	Right Left	10 0	7 2		0.296
Fracture side	Right Left	4 6	6 4		0.083
Primary splintage	Yes No	7 3	7 3		1
Displacement	Posteromedial Posterolateral	8 2	9 1		0.721
Injury to Surgery Time(hrs)*		9.9±3.04	9.6±2.49	0.206	0.419
Reduction	Open Closed	2 8	9 1		0.493
Iatrogenic Ulnar Nerve Injury	Yes No	0 10	2 8		0.95
Post -Op Loss of Reduction	Yes no	0 10	0 10		1
Baumann angle loss		5±0.73	5±0.77		0.288
Carrying angle loss	yes no	0 10	0 10		1
Range of motion	flexion extension total	133 -1 132	127.5 2 129.5		0.5
Flynn criteria	satisfactory unsatisfactory	8 2	8 2		1
Pin infection	yes no	2 8	1 9		0.978
follow up (months)*		6.1±1.50	5.8±1.46	0.34	0.368

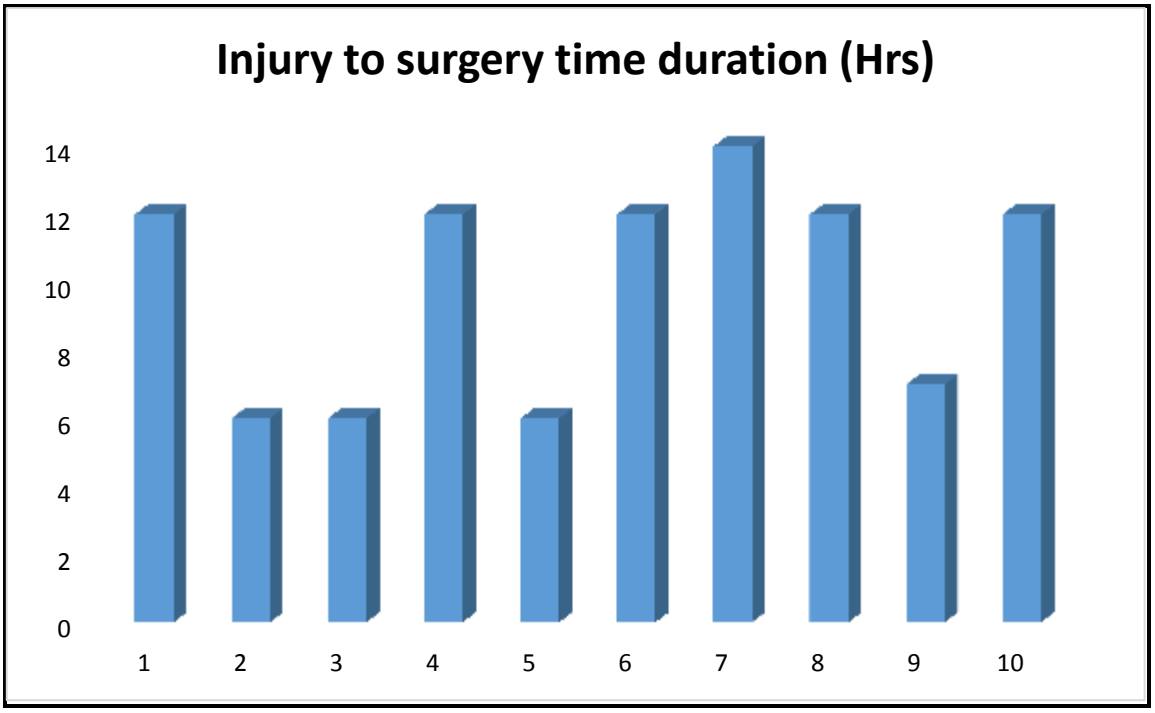
Group A results-(lateral crossed pinning)

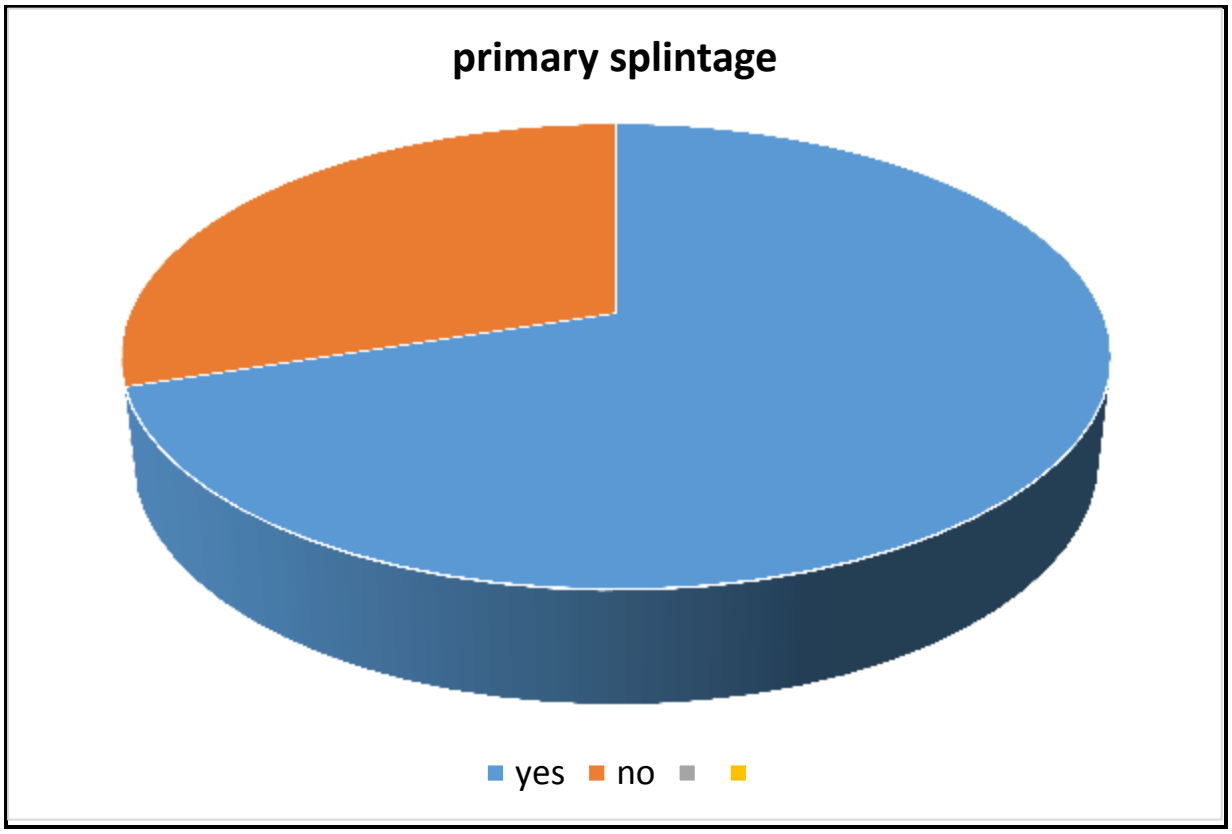


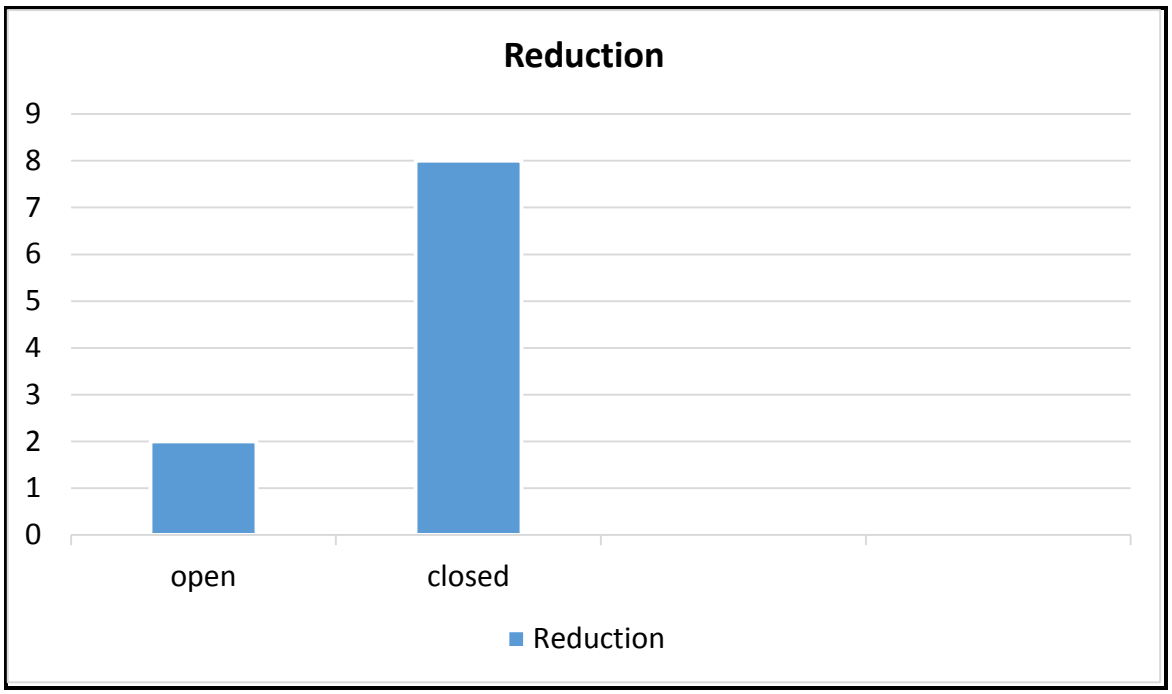


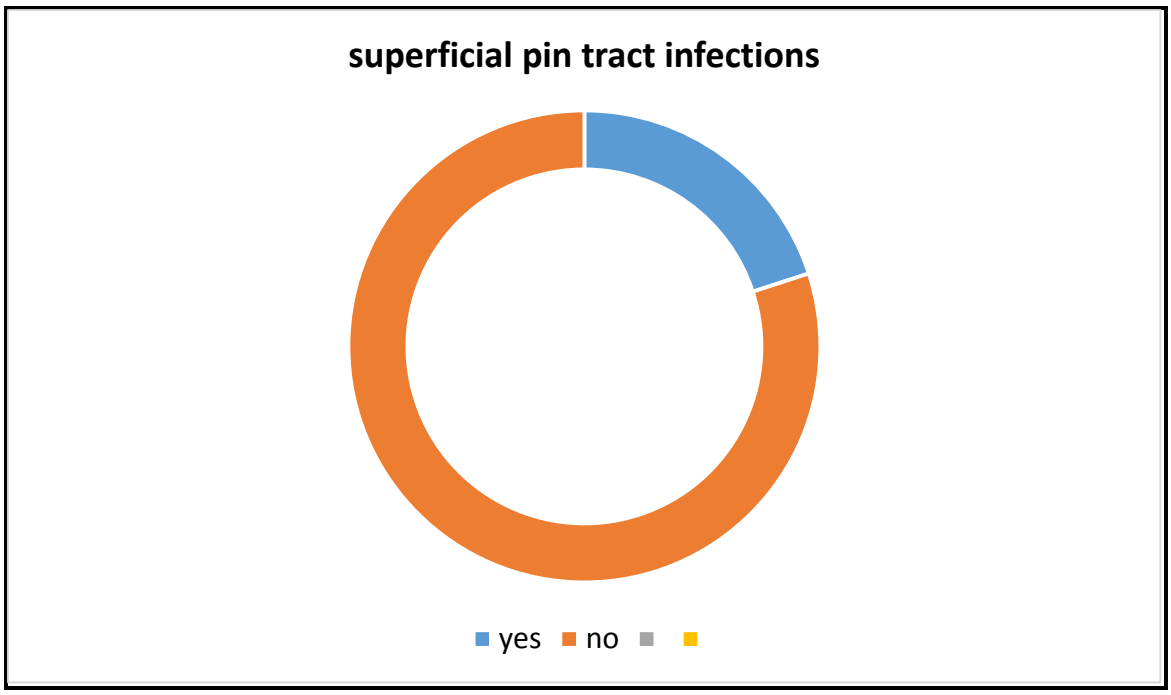

Hand Dominance
12
10
8
6
4
2
0
right
left
Series 1
Column1
Column2

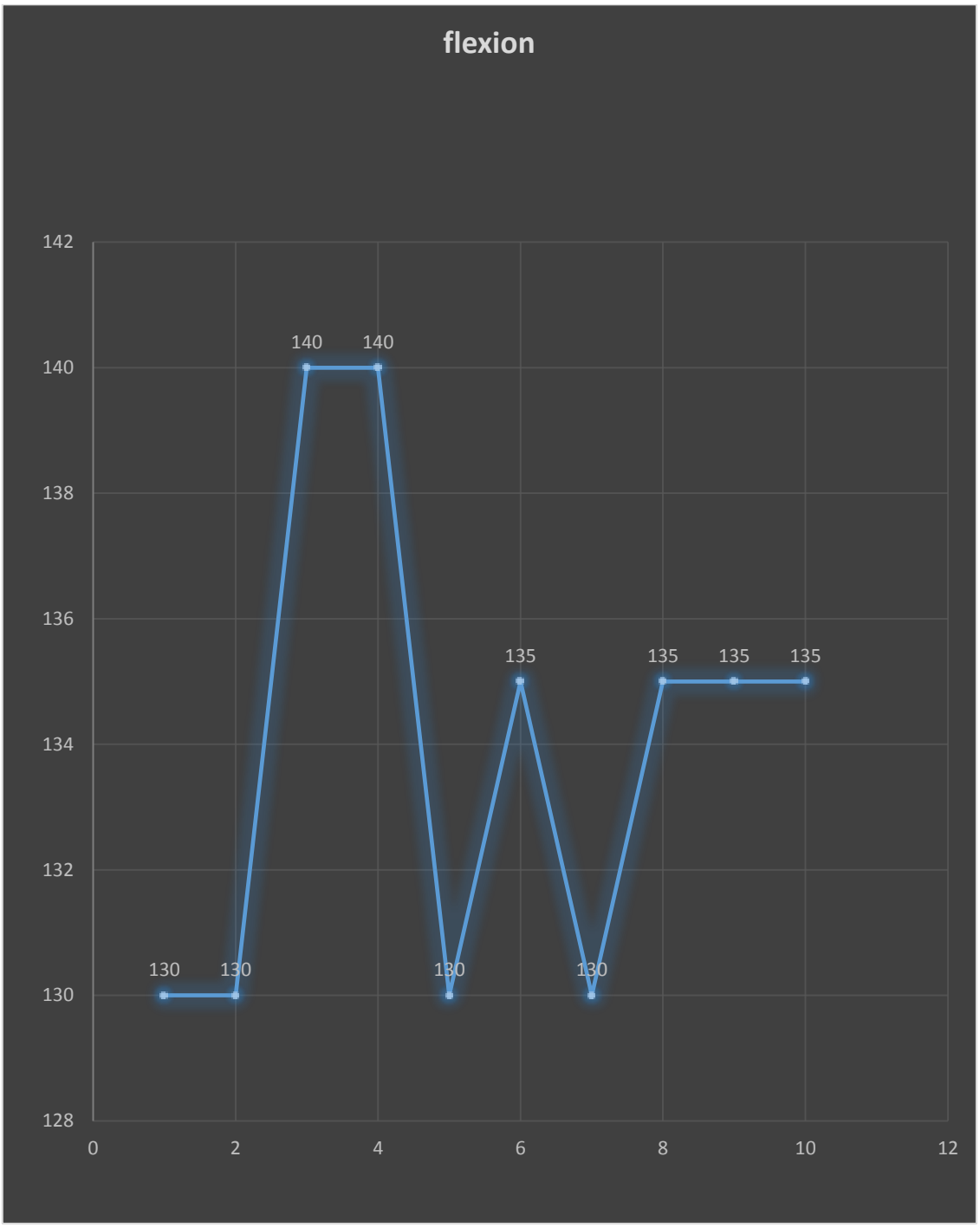

Fracture side
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Right
Left
Series 1
Column1
Column2


Injury to surgery time duration (Hrs)
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10


primary splintage
yes
no


Reduction
9
8
7
6
5
4
3
2
1
0
open
closed
Reduction


superficial pin tract infections
yes
no


flexion
142
140
138
136
134
132
130
128
0
2
4
6
8
10
12
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130
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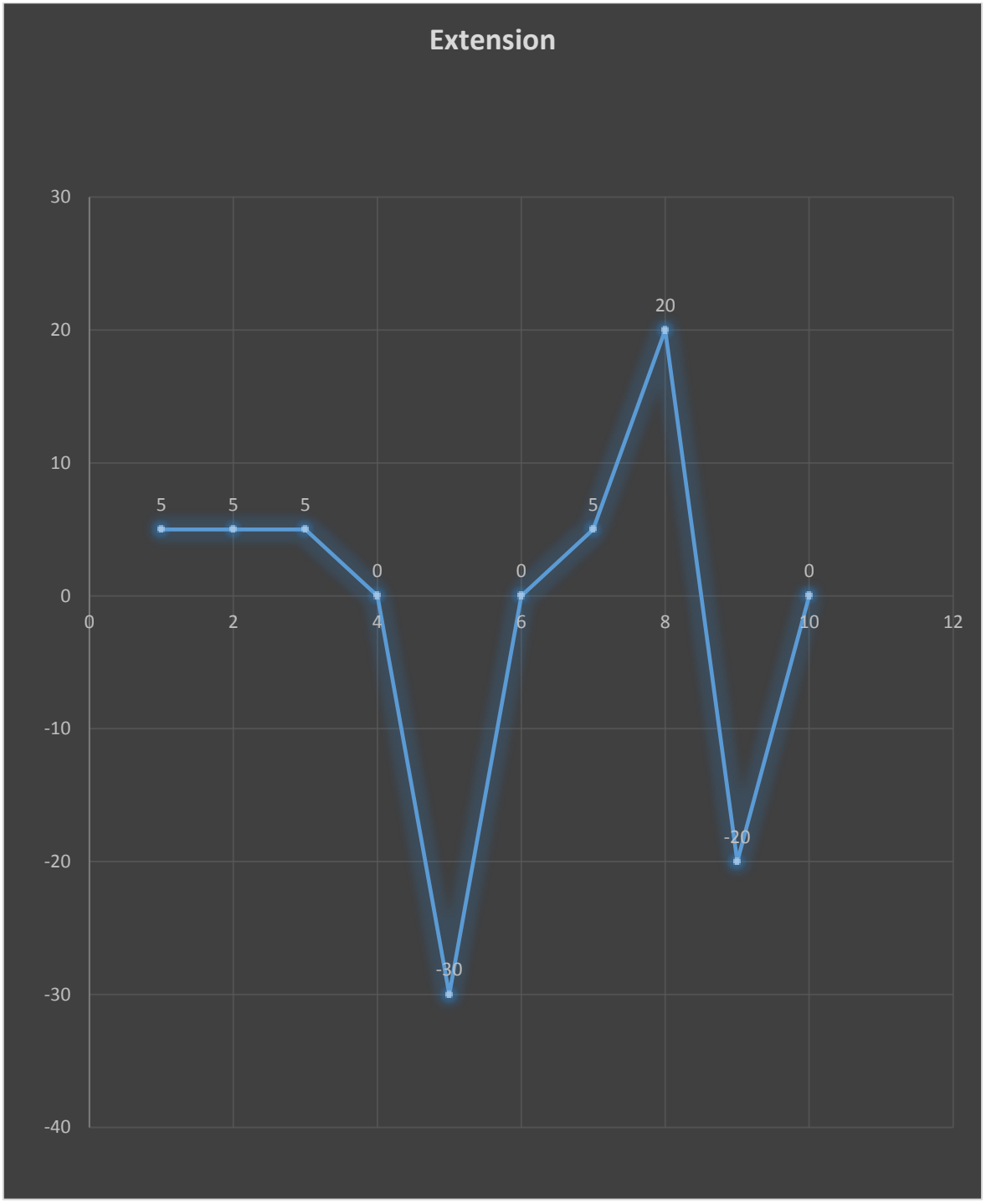
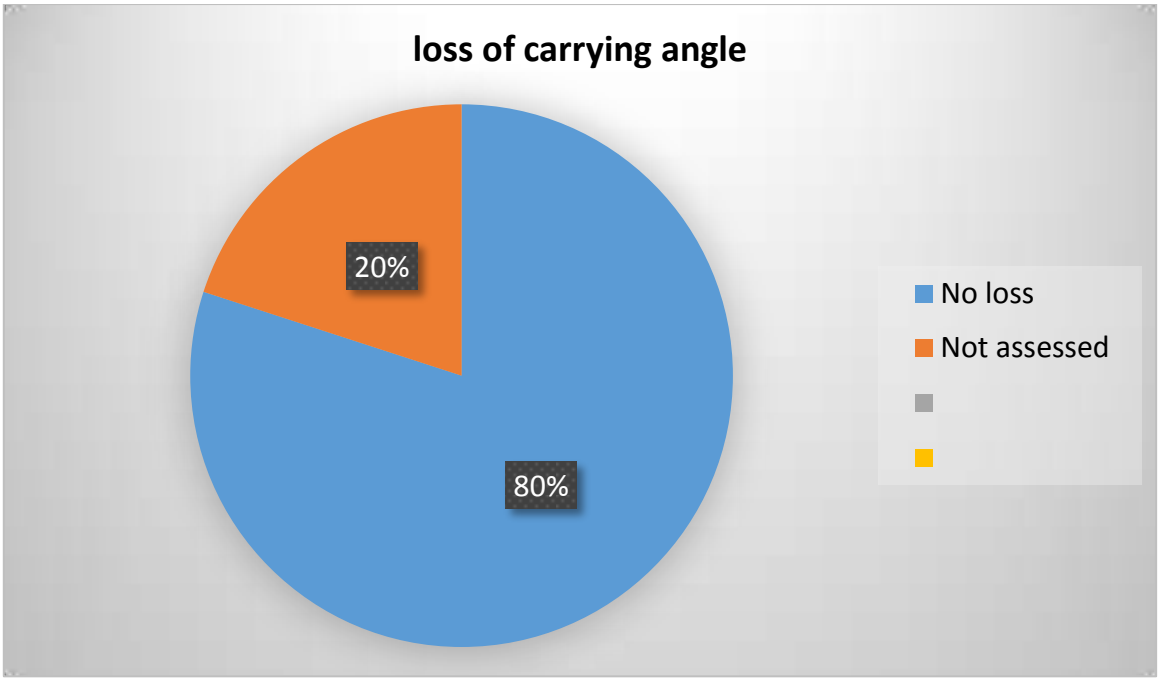
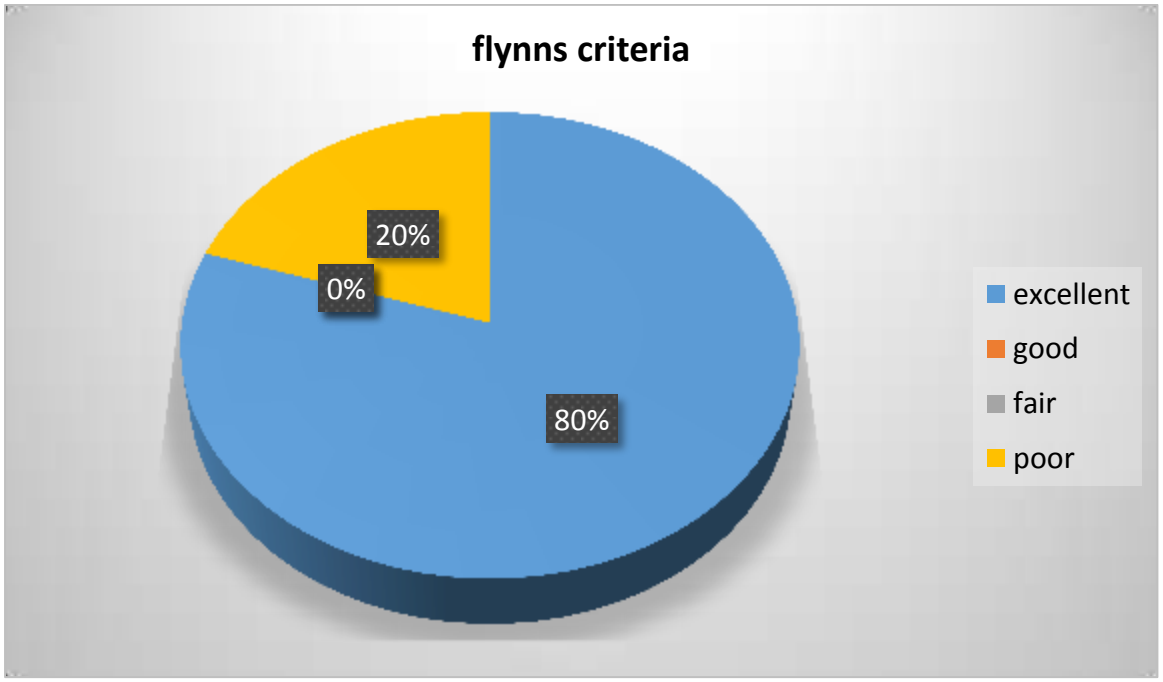
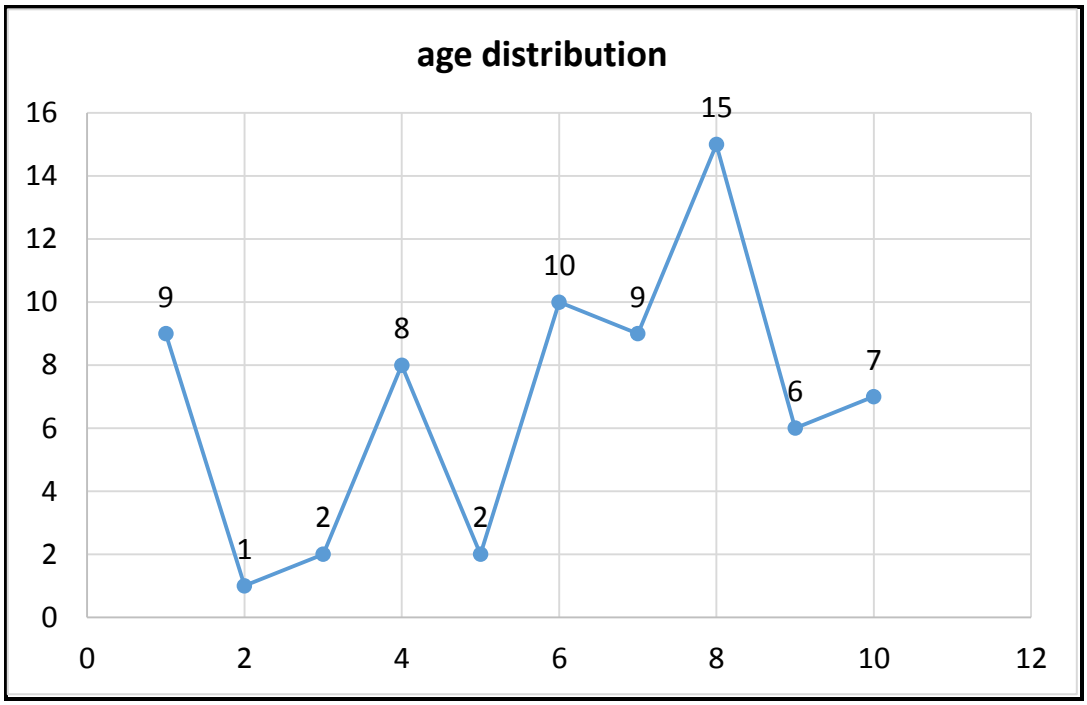
140
130
135
130
135
135
135

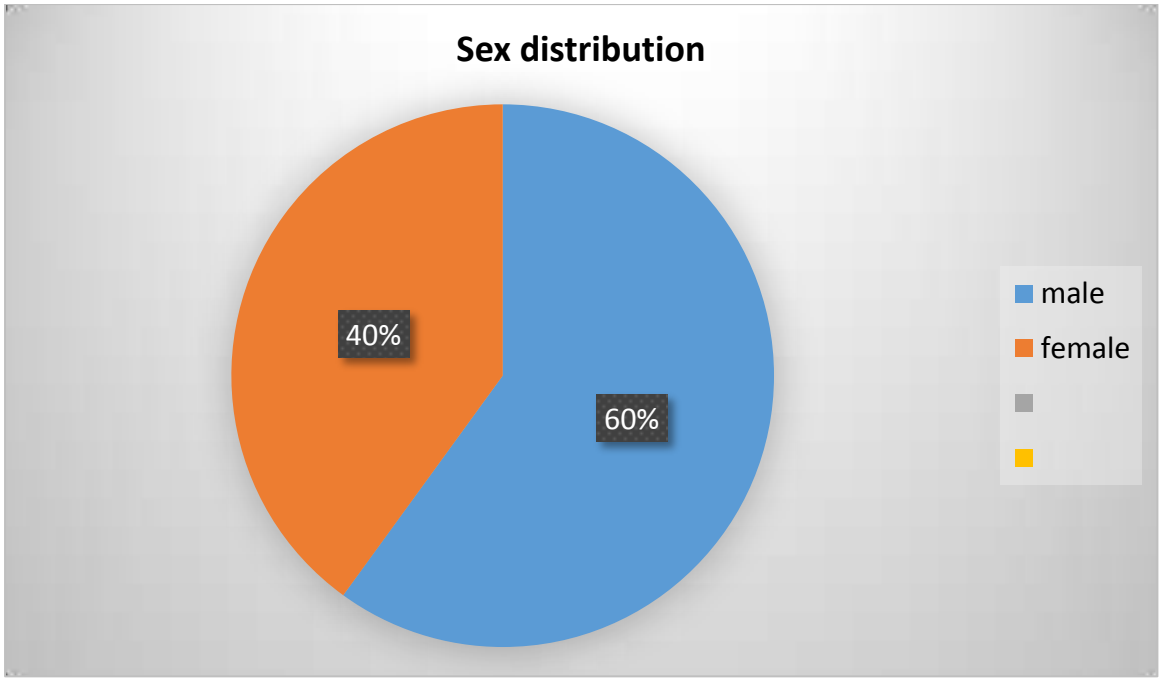

Extension
30
20
10
0
-10
-20
-30
-40
0
2
4
6
8
10
12
5
5
5
0
0
5
20
0
-30
-20

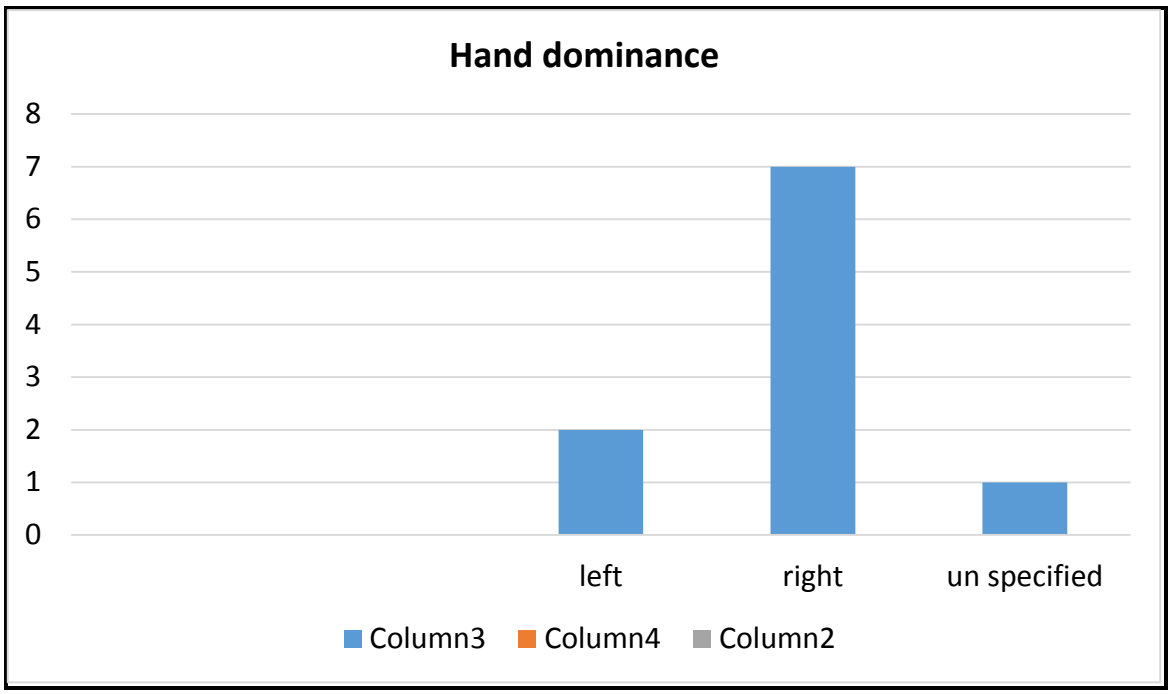

loss of carrying angle
20%
80%
No loss
Not assessed

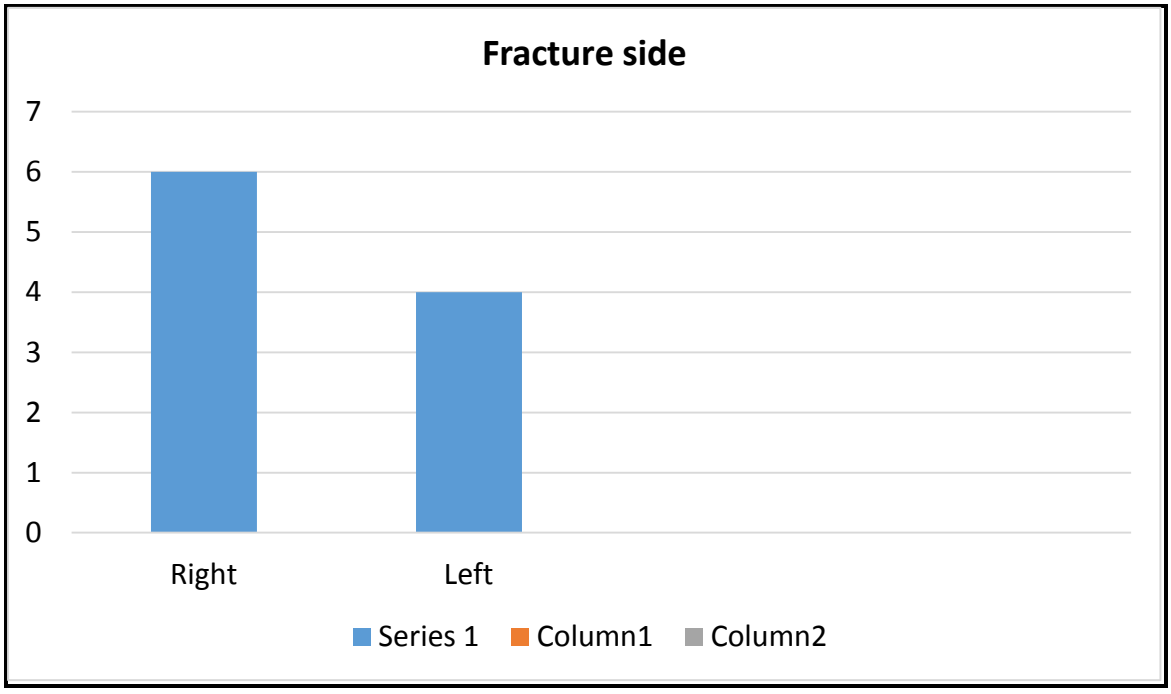

flynns criteria
20%
0%
80%
excellent
good
fair
poor

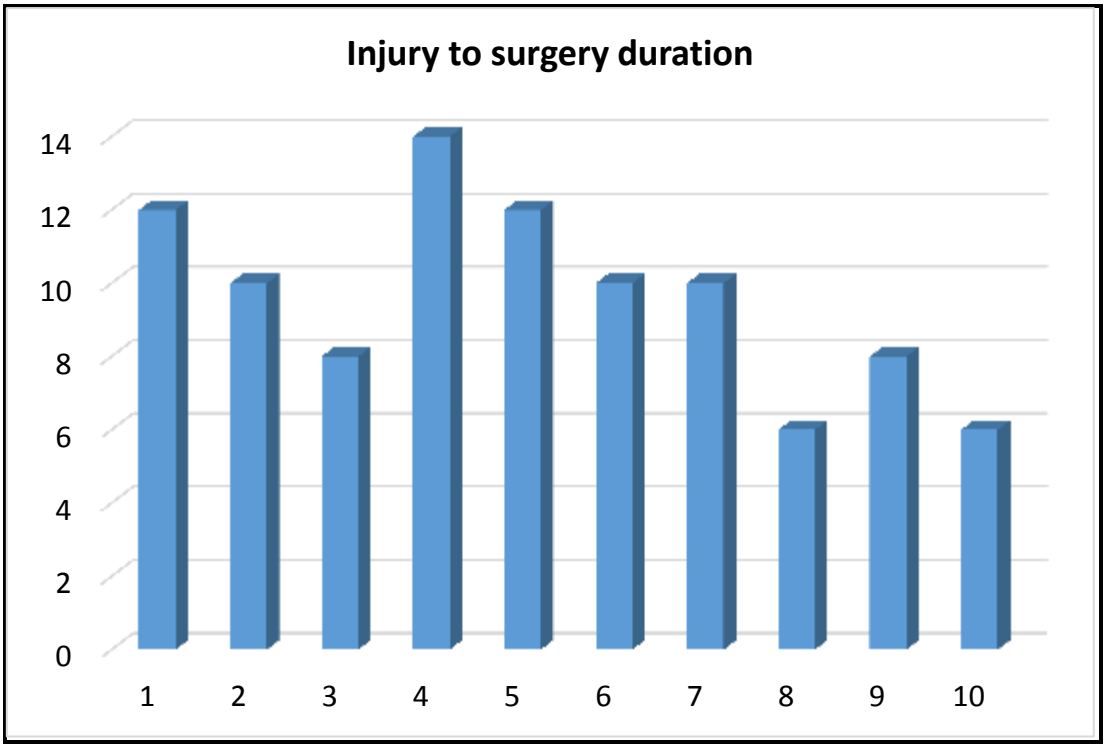
GROUP B RESULTS - (traditional crossed pinning group)

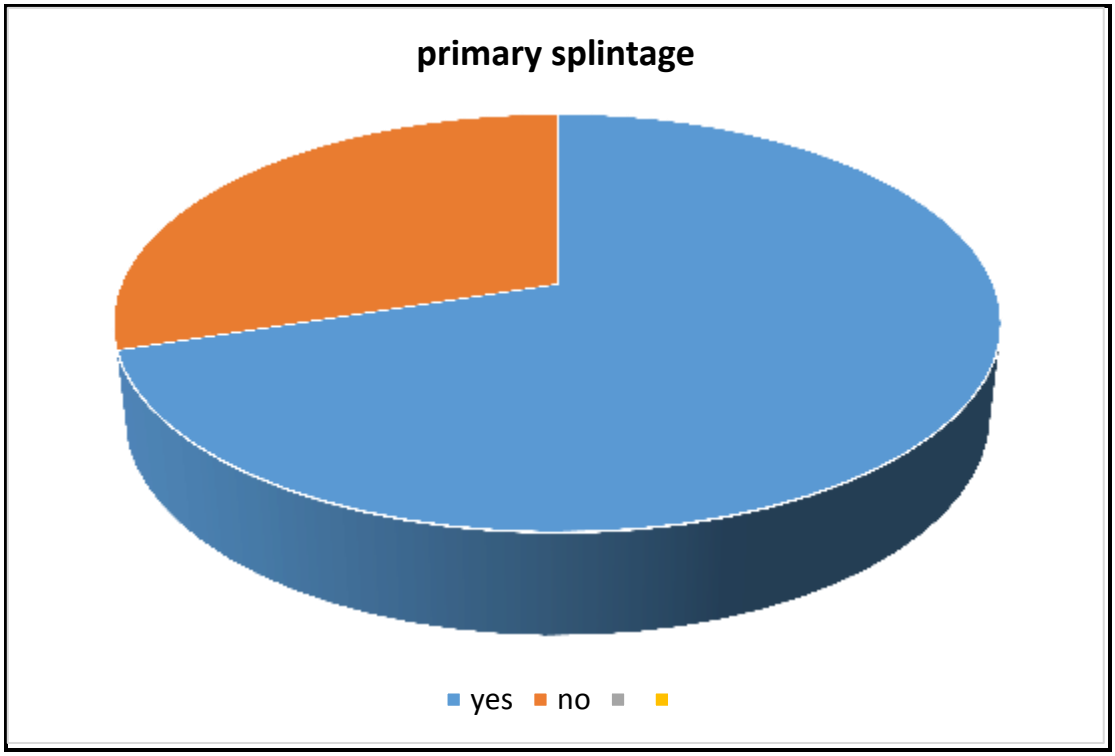


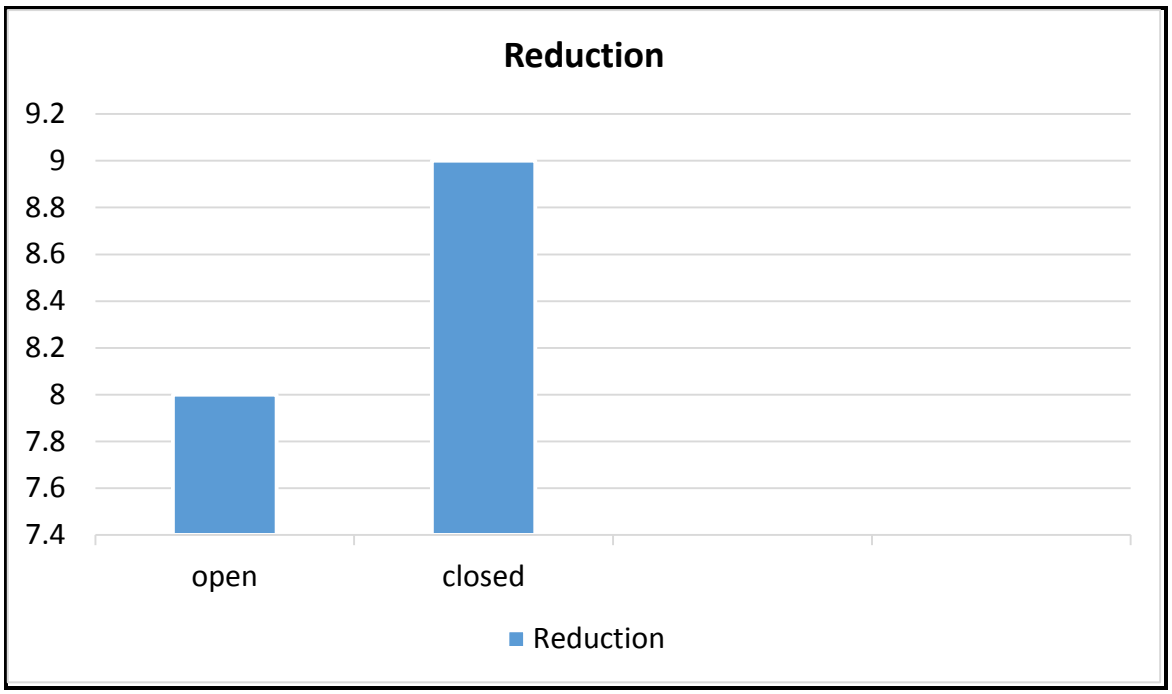


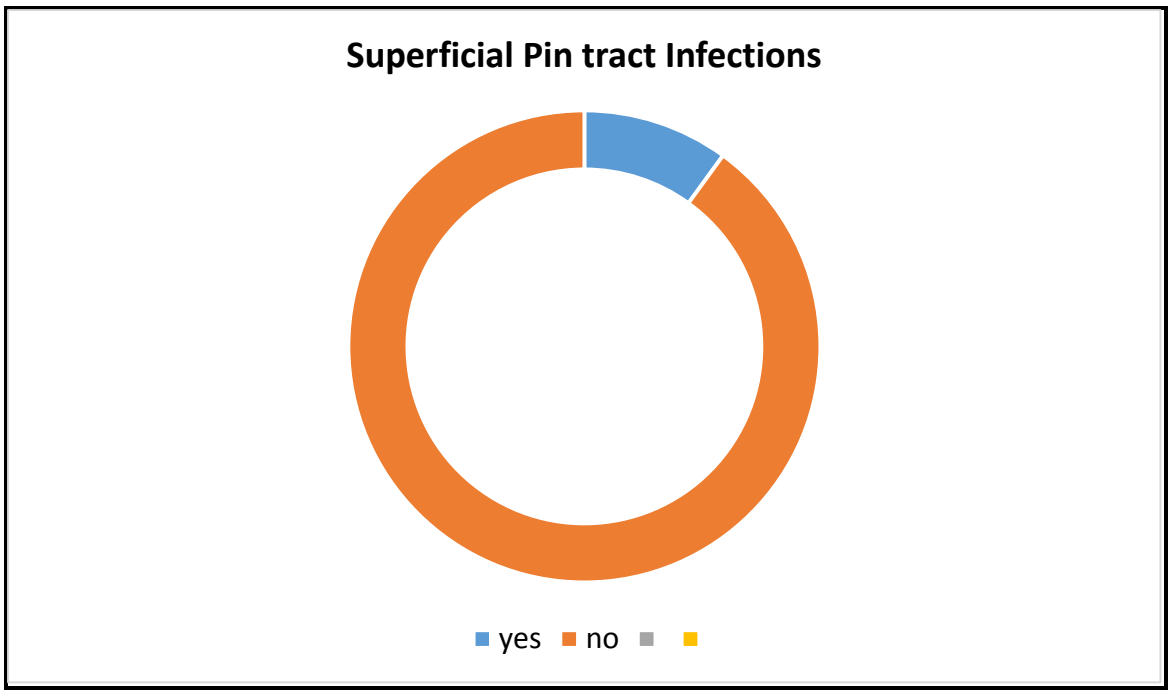

Hand dominance
8
7
6
5
4
3
2
1
0
left
right
un specified
Column3
Column4
Column2

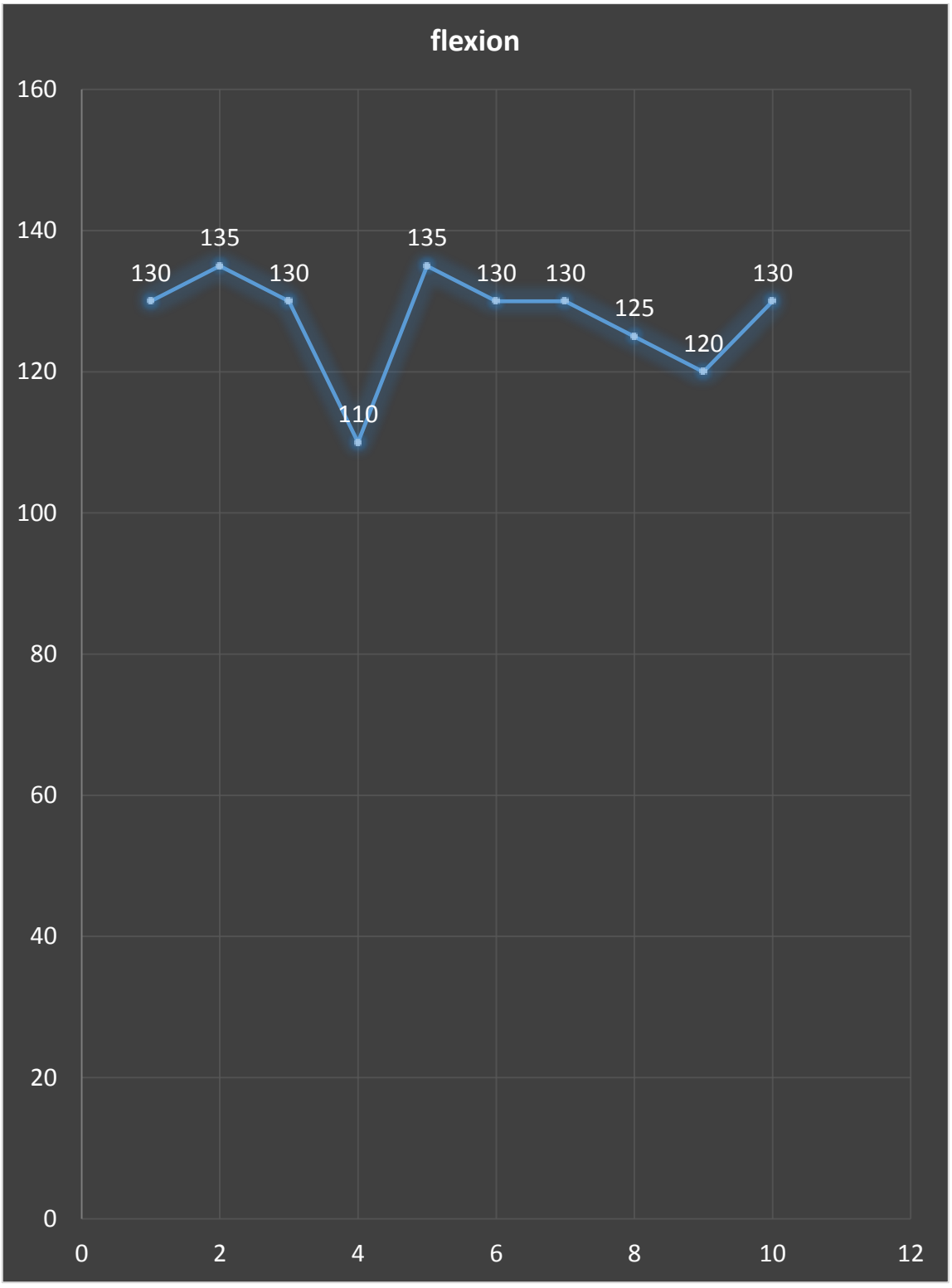

Fracture side
7
6
5
4
3
2
1
0
Right
Left
Series 1
Column1
Column2


Injury to surgery duration
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10


primary splintage
yes
no


Reduction
9.2
9
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
open
closed
Reduction


Superficial Pin tract Infections
yes
no


flexion
160
140
120
100
80
60
40
20
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0
2
4
6
8
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12
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135
130
110
135
130
130
125
120
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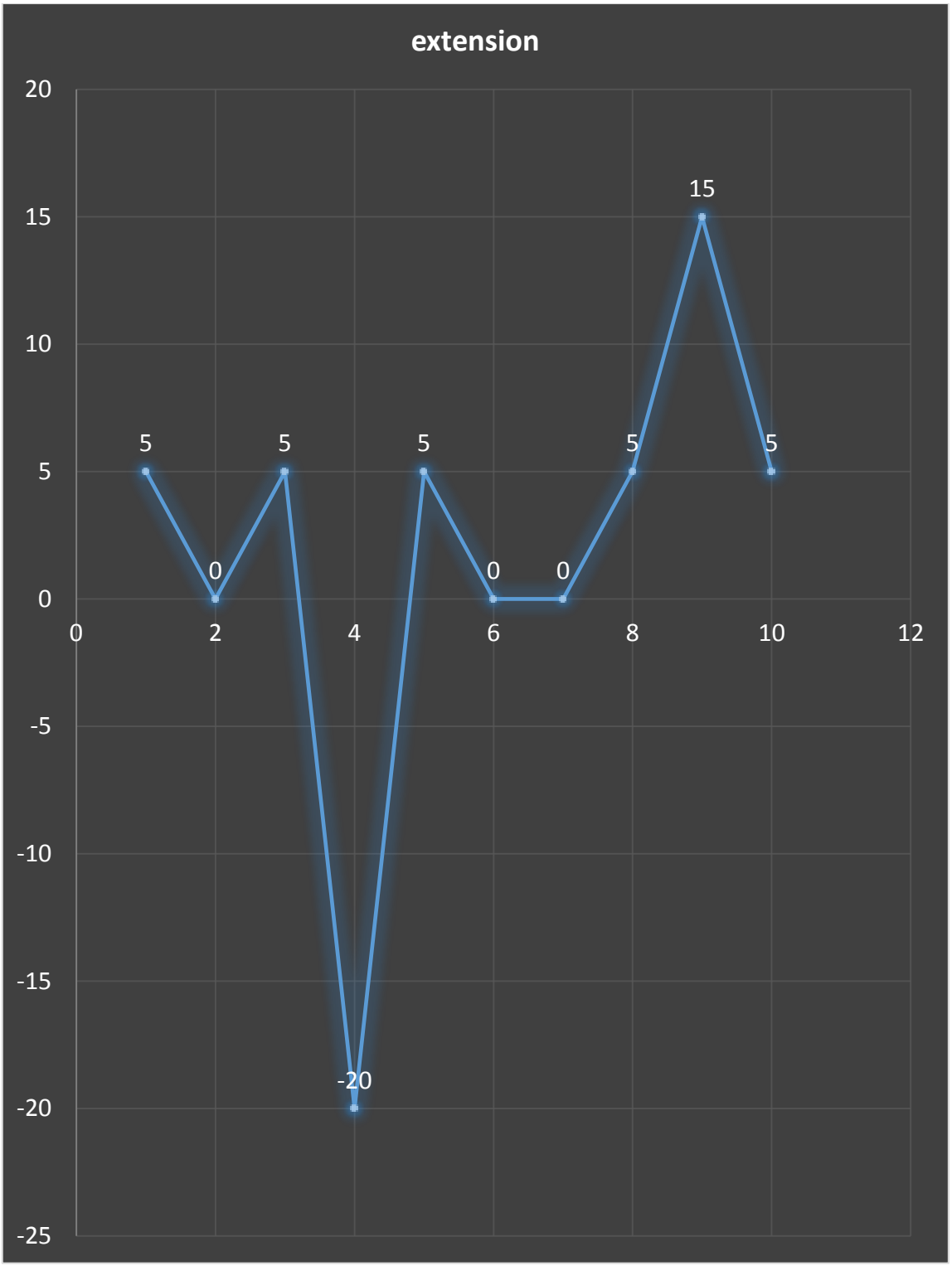
extension
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10
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0
-5
-10
-15
-20
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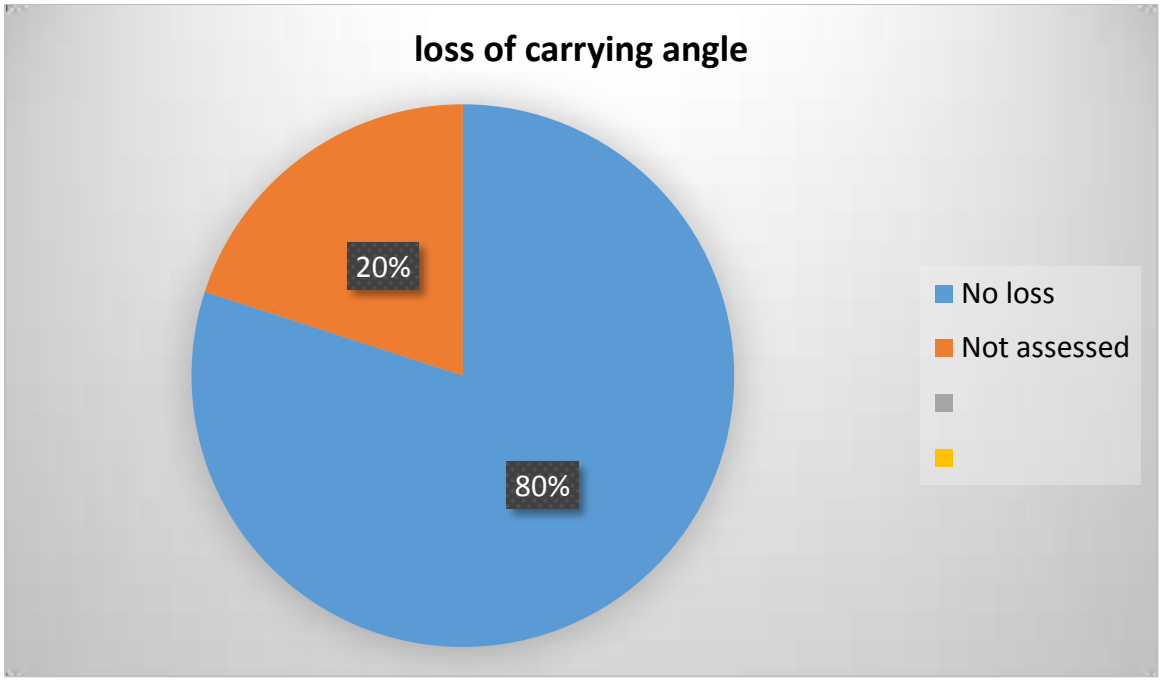
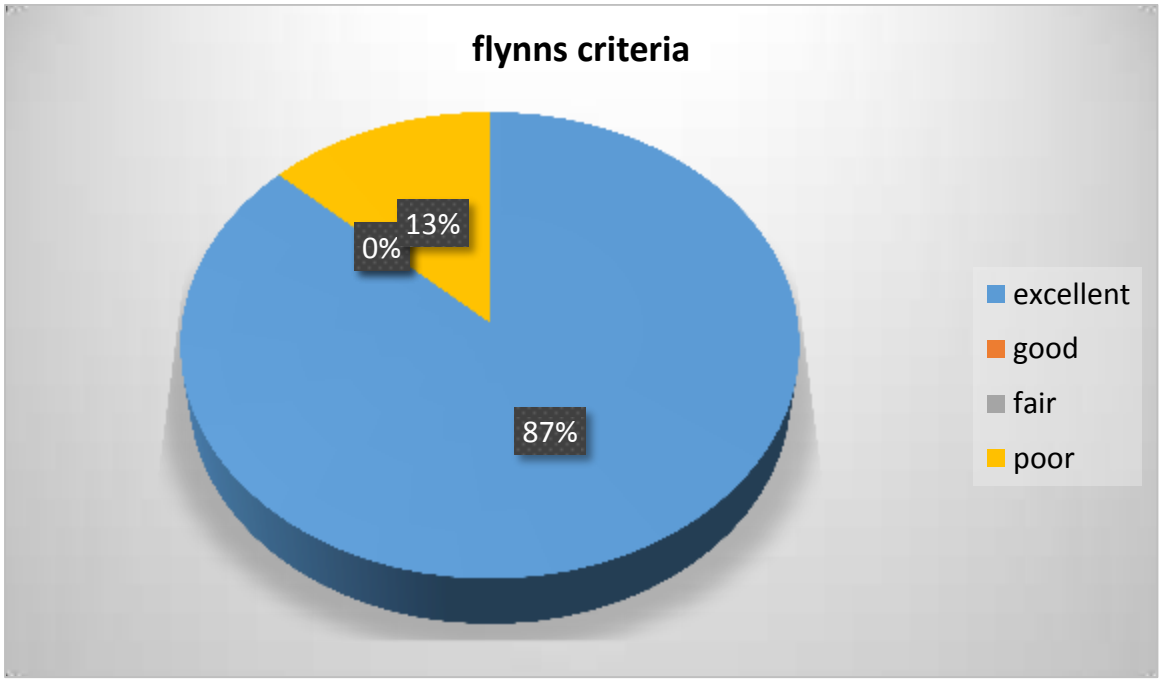
5
-20


loss of carrying angle
20%
80%
No loss
Not assessed


flynns criteria
13%
0%
87%
excellent
good
fair
poor

DISCUSSION

The treatment of displaced supracondylar fractures should ideally be as minimally invasive as possible, they must have a quick learning curve, and they need to carry low rates of complications both early and late.

The cases in the study were studies retrospectively and prospectively using the software designed for **IOTRA** (Institute of orthopaedics and Research Analysis) [11].

Although closed reduction and percutaneous pinning stabilization is the current gold standard in managing displaced supracondylar fractures of the humerus in children, there is still controversy on the pin configuration of K-wires based on fracture stability biomechanics and ulnar nerve safety. In this series, a modified cross wiring technique, performed from the lateral side only ,was studied. In the present study, using Flynn's score [9], 80 % of the patients achieved a satisfactory outcome and 4 patients (20%) achieved unsatisfactory result (loss of range of movement).

A similar series from cekanauskas Emilis et al. [5] achieved 90% excellent or good cosmetic results; yet, 10% were rated as poor. All complications were related to K-wires. Another similar series from Oliver Eberhardt et al. [7] achieved 93% good to excellent functional results. Their cosmetic results were

93% excellent and 7% good, with no poor results. Radiologically, 87% of their cases had a normal humeral shaft condylar angle. There was no case of secondary displacement.

There were no significant complications in the present series other than restricted motion in four cases. Most complications were related to open reduction through a posterior approach and soft tissue contractures. These problems, although important, are not serious, and physio therapy improved range of movements. We found 2 cases of iatrogenic ulnar nerve injuries with 20 % incidence while similar studies report up to 22.50 %[4][6].

We found no cases with secondary loss of reduction which correlates with findings of other case series [5].

In this case series we have found no radial nerve injuries although this technique carries a risk of iatrogenic radial nerve injury reported in some studies as up to 3 %[1].although carefully choosing entry for these lateral pins can reduce these iatrogenic radial nerve injuries[2].

We have used safe zones for pin entry in superolateral aspect of distal humerus to avoid iatrogenic radial nerve injury while inserting anterograde wire[2].

In this series we have not found cases with pin tract infections . In other similar series with lateral cross-pinning with proud wires, the pin complication rate was 4.4 % [5].

In agreement with others [1] [5], all fractures in the present study were immobilized with a long arm splint for 3- 4 weeks before mobilization was permitted. There was no secondary displacement of the fracture after percutaneous pinning with this protocol.

Stability studies had demonstrated that crossed pins provided the best stability Bobby Dezfuli *et al*. [8] They found that the crossed-wire configuration, placed from the medial and the lateral condyles, was the most stable arrangement. They promoted the use of the crossed-pin configuration, but mentioned that with significant swelling, the two lateral parallel pins could be considered as an inferior but acceptable option.

Although Dorgan's technique doesn't satisfy all pinning principles, the crossed-wire configuration obtained by inserting both wires from the lateral side is similar to that obtained by the traditional medial and lateral technique [8].

CONCLUSION

This study shows that incidence of iatrogenic ulnar nerve injury in traditional crossed pinning is high .

No significant difference exist with respect to fracture characteristics, loss of reduction on follow-up, pin tract infection except for iatrogenic ulnar nerve injury in traditional pinning.

There was no major complication apart from ulnar nerve injury in either of the groups .

Functional outcome in both the groups appears to be the same. This technique is however technically challenging and imperative to do it under fluoroscopy guidance .

To conclude lateral crossed pinning in supracondylar humerus fractures can be used as an alternative to crossed pinning techniques especially in very unstable fractures where lateral only pinning cannot give enough stability and it gives good results when general principles of surgery are followed with a lower risk of iatrogenic ulnar nerve injuries.

ILLUSTRATIVE CASES

Case1

At presentation

Post operative intact distal neurovascularity

At final follow-up

Case 2

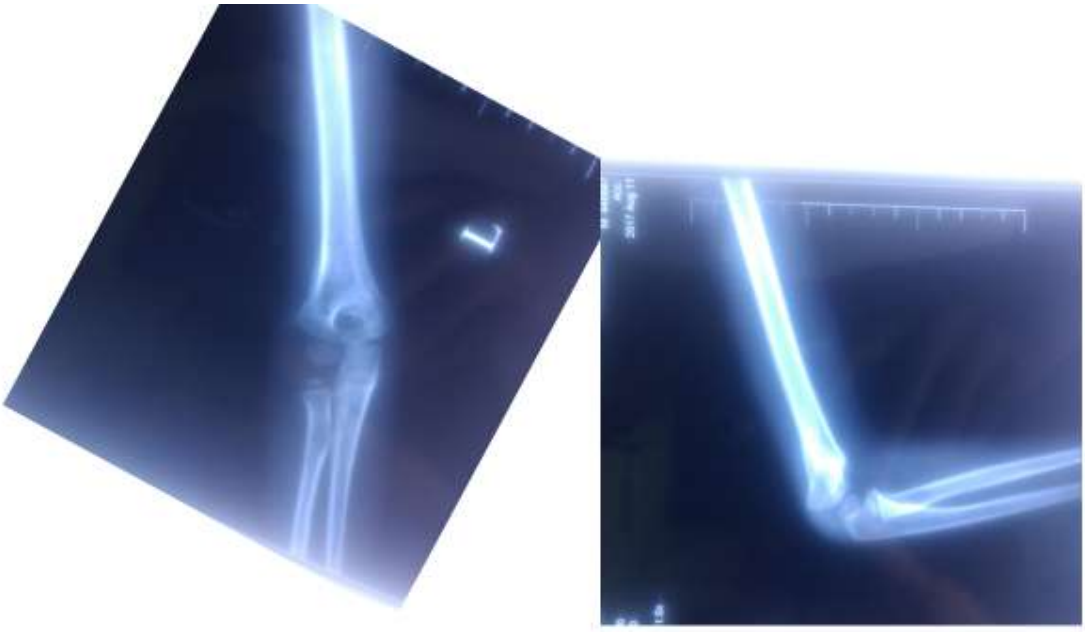
Trauma xrays

Immediate post op

Pin tracts healthy

Post op 4 weeks

Final Followup



Radiological union

Case 3

Trauma xrays

Immediate postop

At Final followup.

Case 4

At presentation

Immediate post op

At 4 weeks

At final follwup

Case 5

Ulnar calwing


JANA/490446/44 yea
B.I.R. RAJIV GANDHI GOVT GEN


VT GEN HOSPITAL CHENNAI

BIBLIOGRAPHY

1. Comparative Evaluation of Results of Cross Pin Fixation by Conventional Method with Dorgan's Method in Displaced Supracondylar Fracture in Children Prasanta Kumar Saha et al International Journal of Scientifi c Study | September 2015 | Vol 3 | Issue 6

2. Safe Zone for Superolateral Entry Pin into the Distal Humerus in Children: A MRI Analysis Tamir Bloom, MD* et al Clin Orthop Relat Res (2014) 472:3779–3788

3. Percutaneous lateral cross-pinning of paediatric supracondylar humeral fractures Mohamad Osman et al **Egyptian Orthopedic Journal 2014,** 49:188–192

4. Modified Dorgan technique versus Cross pinning in displaced supracondylar humeral fractures in children: how to avoid iatrogenic ulnar neuropathy ? Cekanauskas Emilis, et al

5. A prospective randomised non-blinded comparison of conventional and Dorgan's crossed pins for paediatric supracondylar humeral fractures Sinisa Ducic et al Injury, Int. J. Care JINJ 6897

6. Comparison of traditional and Dorgan's lateral crosswiring of supracondylar humerus fractures in children Mehmet A. Altay et al Saudi

Med J 2010; Vol. 31 (7)

7. Cross pinning of supracondylar fractures from a lateral approach. Stabilization achieved with safety Oliver Eberhardt et al J Child Orthop (2007) 1:127–133
8. Pediatric Supracondylar Humerus Fractures: Are Medial Pins Indicated? Bobby Dezfuli et al Open Journal of Orthopedics, 2014, 4, 123-129
9. Rating systems for evaluation of the elbow Umile Giuseppe Longo et al. British Medical Bulletin 2008; 87: 131–161
10. A Comparative Study Of Incidence Of Iatrogenic Ulnar Nerve Injuries In Two Different Techniques Of Cross Kirschner Wire Configuration For Fixation Of Paediatric Supracondylar Fractures Of Humerus Abdul Latif Sami et al. ANNALS VOL 21, ISSUE 3, JUL. – SEP. 2015
11. **IOTRA** wing (institute of orthopaedics Research analysis)

PROFORMA

Name :

Age :

Sex :

Side of injury:

Hand dominance:

Mode of injury :

Time of injury :

Time of presentation to medical care :

Time to surgery :

Primary splintage :

Open/ closed injury :

Neurovascular deficit (yes/no):

Xray

Type of fracture :

Displacement :

Surgery

Open / closed reduction :

Cross pinning technique and configuration :

Post op loss of reduction :

Range of motion :

Carrying angle :

Baumann angle loss:

Neurovascular deficit if any:

Pin tract infection :

Post op complication (early / late) if any :

Restrictions in activities of daily living if any :

Flynns criteria:

Follow-up period :

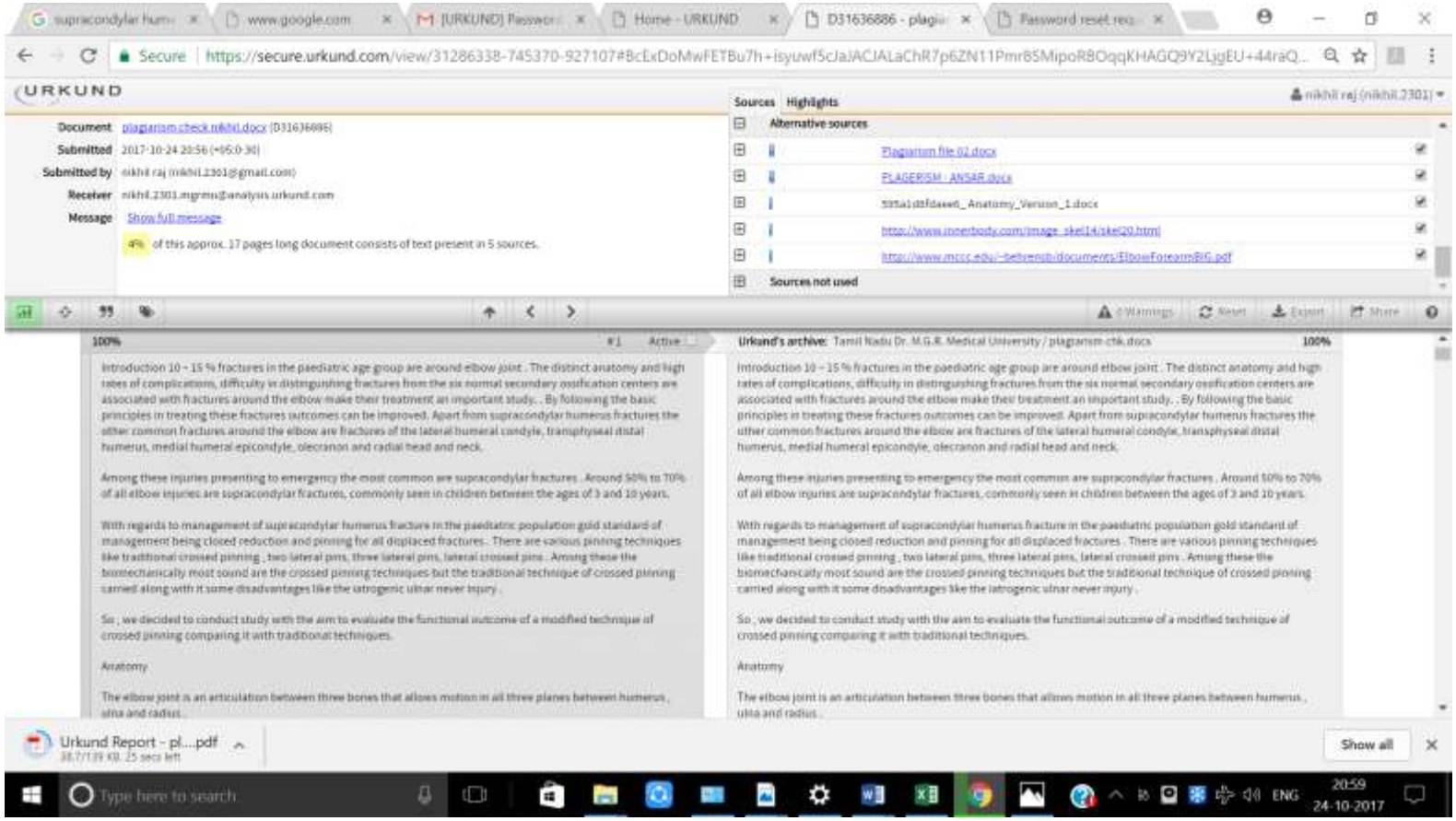
Score

Outcome	Loss of carrying angle	Loss in elbow motion
Excellent	0-5 degrees	0-5 degrees
Good	6 - 10 degrees	6 - 10 degrees
Fair	11-15 degrees	11-15 degrees
Poor	more than 15 degrees	more than 15 degrees

Poor – unsatisfactory

Fair ,good and excellent being satisfactory.

Any post operative neurovascular deficit is unsatisfactory


supracondylar humu
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Password reset requ
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Introduction 10 – 15 % fractures in the paediatric age group are around elbow joint . The distinct anatomy and high rates of complications, difficulty in distinguishing fractures from the six normal secondary ossification centers are associated with fractures around the elbow make their treatment an important study. . By following the basic principles in treating these fractures outcomes can be improved. Apart from supracondylar humerus fractures the other common fractures around the elbow are fractures of the lateral humeral condyle, transphyseal distal humerus, medial humeral epicondyle, olecranon and radial head and neck.
Among these injuries presenting to emergency the most common are supracondylar fractures . Around 50% to 70% of all elbow injuries are supracondylar fractures, commonly seen in children between the ages of 3 and 10 years.
With regards to management of supracondylar humerus fracture in the paediatric population gold standard of management being closed reduction and pinning for all displaced fractures . There are various pinning techniques like traditional crossed pinning , two lateral pins, three lateral pins, lateral crossed pins . Among these the biomechanically most sound are the crossed pinning techniques but the traditional technique of crossed pinning carried along with it some disadvantages like the iatrogenic ulnar never injury .
So , we decided to conduct study with the aim to evaluate the functional outcome of a modified technique of crossed pinning comparing it with traditional techniques.
Anatomy
The elbow joint is an articulation between three bones that allows motion in all three planes between humerus , ulna and radius .
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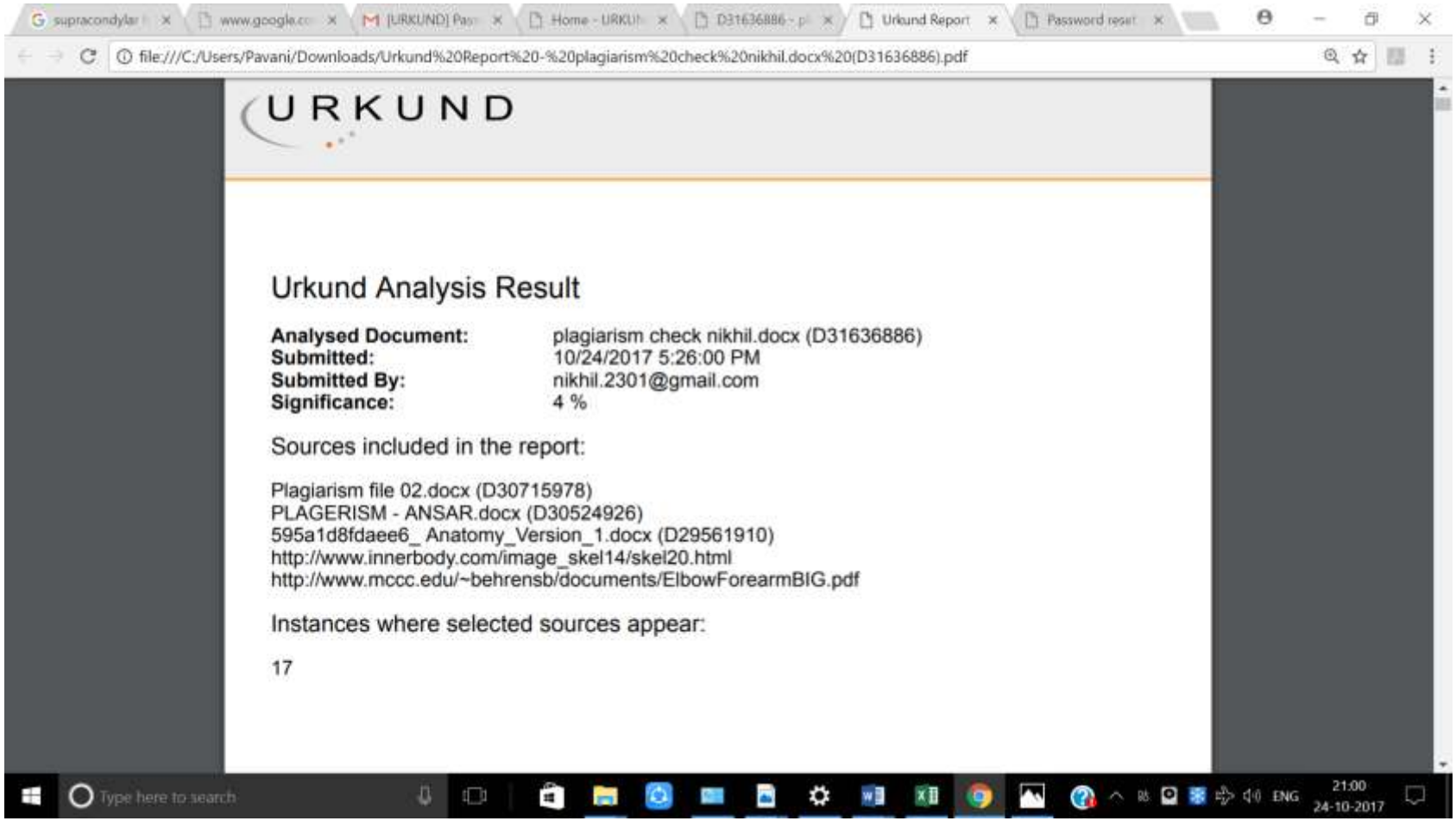
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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To
Dr.K.Nikhil Raj
Post Graduate in M.S.Orthopaedics
Institute of Orthopaedics & Traumatology
Madras Medical College
Chennai 600 003

Dear Dr.K.Nikhil Raj,

The Institutional Ethics Committee has considered your request and approved your study titled **"RETROSPECTIVE AND PROSPECTIVE STUDY COMPARING TRADITIONAL AND DORGAN'S PINNING TECHNIQUE IN SUPRACONDYLAR HUMERUS FRACTURES OF CHILDREN" - NO.09012017 (III).**

The following members of Ethics Committee were present in the meeting hold on **24.01.2017** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.M.K.Muralidharan,MS.,M.Ch.,Dean, MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4.Prof.B.Vasanthi,MD., Prof.of Pharmacology.,MMC,Ch-3	: Member
5.Prof.A.Rajendran,MS, Prof. of Surgery,MMC,Ch-3	: Member
6.Prof.N.Gopalakrishnan,MD,Director,Inst.of Nephrology,MMC,Ch	: Member
7.Prof.Baby Vasumathi,MD.,Director, Inst. of O & G	: Member
8.Prof.K.Ramadevi,MD.,Director,Inst.of Bio-Che,MMC,Ch-3	: Member
9.Prof.R.Padmavathy, MD, Director,Inst.of Pathology,MMC,Ch-3	: Member
10.Prof.S.Mayilvahanan,MD,Director, Inst. of Int.Med,MMC, Ch-3	: Member
11.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
12.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
13.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

23/1/17

Member Secretary - Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003.

ஒப்புதல் படிவம்

ஆராய்ச்சி மையம்: **இராஜீவ் காந்தி அரசு பொது மருத்துவமனை மற்றும் மருத்துவக் கல்லூரி, சென்னை.**

நோயாளியின் பெயர்: நோயாளியின் வயது:

பதிவு எண்:

நோயாளி கீழ்கண்டவற்றுள் கட்டங்களை (✓) செய்யவும்

1. மேற்குறிப்பிட்டுள்ள ஆராய்ச்சியின் நோக்கத்தையும் பயனையும் முழுவதுமாக புரிந்து கொண்டேன். மேலும் எனது அனைத்து சந்தேகங்களையும் கேட்டு அதற்கான விளக்கங்களையும் தெளிவுபடுத்திக் கொண்டேன்.
2 மேலும் இந்த ஆராய்ச்சிக்கு எனது சொந்த விருப்பத்தின் பேரில் பங்கேற்கிறேன் என்றும், மேலும் எந்த நேரத்திலும் எவ்வித முன்னறிவிப்புமின்றி இந்த ஆராய்ச்சியிலிருந்து விலக முழுமையான உரிமை உள்ளதையும், இதற்கு எவ்விட சட்ட பிணைப்பும் இல்லை என்பதையும் அறிவேன்.
3 ஆராய்ச்சியாளரோ, ஆராய்ச்சி உதவியாளரோ, ஆராய்ச்சி உபயத்தாரோ, ஆராய்ச்சி பேராசிரியரோ, ஒழுங்குநெறி செயற்குழு உறுப்பினர்களோ எப்போது வேண்டுமானாலும் எனது அனுமதியின்றி எனது உள்நோயாளி பதிவுகளை இந்த ஆராய்ச்சிக்காகவோ அல்லது எதிர்கால பிற ஆராய்ச்சிகளுக்காகவோ பயன்படுத்திக் கொள்ளலாம் என்றும், மேலும் இந்த நிபந்தனை நான் இவ்வாராய்ச்சியிலிருந்து விலகினாலும் தகும் என்றும் ஒப்புக் கொள்கிறேன். ஆயினும் எனது அடையாளம் சம்பந்தப்பட்ட எந்த பதிவுகளும் (சட்டப்பூர்வமான தேவைகள் தவிர) வெளியிடப்படமாட்டாது என்ற உறுதிமொழியின் பெயரில் இந்த ஆராய்ச்சியிலிருந்து கிடைக்கப்பெறும் முடிவுகளை வெளியிட மறுப்பு தெரிவிக்கமாட்டேன் என்று உறுதியளிக்கிறேன்
4 இந்த ஆராய்ச்சிக்கு நான் முழுமனதுடன் சம்மதிக்கிறேன் என்றும் மேலும் ஆராய்ச்சிக் குழுவினர் எனக்கு அளிக்கும் அறிவுரைகளை தவறாது பின்பற்றுவேன் என்றும் இந்த ஆராய்ச்சி காலம் முழுவதும் எனது உடல் நிலையில் ஏதேனும் மாற்றமோ அல்லது எதிர்பாராத பாதகமான விளைவோ ஏற்படுமாயின் உடனடியாக ஆராய்ச்சி குழுவினரை அணுகுவேன் என்றும் உறுதியளிக்கிறேன்.
5 இந்த ஆராய்ச்சிக்குத் தேவைப்படும் அனைத்து மருத்துவப் பரிசோதனைகளுக்கும் ஒத்துழைப்பு தருவேன் என்று உறுதியளிக்கின்றேன்.
6 இந்த ஆராய்ச்சிக்கு யாருடைய வற்புறுத்தலுமின்றி சொந்த விருப்பத்தின் பேரிலும் சுய அறிவுடனும் முழுமனதுடனும் சம்மதிக்கிறேன் என்று இதன் மூலம் ஒப்புக் கொள்கிறேன்.

நோயாளியின் கையொப்பம்/ பெருவிரல் ரேகை

ஆராய்ச்சியாளரின் கையொப்பம்

இடம்:

தேதி:

MASTER CHART - GROUP A

CASE	AGE	SEX	HAND DOMINANCE	fracture side	FRACTURE TYPE	TIME DELAY TO PRESENATION	TIME DELAY TO SURGERY (hrs)	CLOSED /OPEN	extension	flexion	total range	CARRYING ANGLE LOSS
PREETHI	10	F	RIGHT	left	TYPE III	8	12	CLOSED	5	130	135	NIL
JANA	12	M	RIGHT	left	TYPE III	6	6	CLOSED	5	130	135	NIL
SANDEEP	10	M	RIGHT	right	TYPE III	12	6	CLOSED	5	140	145	NIL
VIGNESH	9	M	RIGHT	left	TYPE III	8	12	CLOSED	0	140	140	NIL
SATHISH KUMAR	13	M	RIGHT	right	TYPE III	12	6	OPEN	-30	130	100	NA
SEJEL	10	M	RIGHT	left	TYPE III	2	12	CLOSED	0	135	135	NIL
DHARSHAN	8	M	RIGHT	right	TYPE III	4	14	CLOSED	5	130	135	NIL
MUSTAFA	13	M	RIGHT	left	TYPE III	2	12	CLOSED	20	135	130	NIL
YUVA SELVARAJ	10	M	RIGHT	right	TYPE III	8	7	OPEN	-20	135	110	NA
JEYA SREE	4	F	RIGHT	left	TYPE III	6	12	CLOSED	0	135	130	NIL

FLYNN CRITERIA	POST OP NEUROVASCULAR DEFICIT	DAILY ACTIVITY FUNCTIONAL LIMITATION	INITIAL PIN CONFIGURATION	POST OPERATIVE LOSS OF REDUCTION	PIN TRACT INFECTION	Mode of injury	Bauman angle loss	primary splintage	Displacement	followup
SATISFACTORY -E	NIL	NIL	A-2 R1	NIL	NIL	fall	4	yes	PM	4
SATISFACTORY -E	NIL	NIL	A2 R1	NIL	NIL	fall	6	yes	PM	5
SATISFACTORY -E	NIL	NIL	A2 R1	NIL	NIL	fall	5	yes	PM	4
SATISFACTORY -E	NIL	NIL	A2 R1	NIL	NIL	rta	4	no	PM	6
UNSATISFACTORY	NIL	NIL	A2 R1	NIL	NIL	fall	5	yes	PM	9
SATISFACTORY -E	NIL	NIL	A1 R1	NIL	NIL	fall	6	yes	PL	8
SATISFACTORY -E	NIL	NIL	A1 R2	NIL	NIL	fall	5	no	PM	5
SATISFACTORY -E	NIL	NIL	A1 R1	NIL	yes	fall	4	yes	PM	6
UNSATISFACTORY	NIL	NIL	A2R1	NIL	NIL	fall	6	no	PL	7
SATISFACTORY -E	NIL	NIL	A2R1	NIL	yes	fall	5	yes	PM	7

MASTER CHART- GROUP B

CASE	AGE	SEX	HAND DOMINANCE	fracture side	FRACTURE TYPE	TIME DELAY TO PRESENATION	TIME DELAY TO SURGERY (hrs)	CLOSED /OPEN	extension	flexion	total range	CARRYING ANGLE LOSS	FLYNN CRITERIA	POST OP NEUROVASCULAR DEFICIT
mohan babu	9	m	right	right	type III	8	12	closed	5	130	135	nil	SATISFACTORY -E	nil
sai vaishnavi	1	f	nil	right	type III	6	10	closed	0	135	135	nil	SATISFACTORY -E	nil
shivani	2	f	right	left	type III	4	8	closed	5	130	135	nil	SATISFACTORY -E	nil
dilip kumar	8	m	left	right	type III	12	14	open	-20	110	90	NE	UNSATISFACTORY	yes
diyana	2	f	right	left	type III	10	12	closed	5	135	140	nil	SATISFACTORY -E	nil
saivaishnavi	10	f	right	right	type III	6	10	closed	0	130	130	nil	SATISFACTORY -E	nil
harish	9	m	right	right	type III	8	10	closed	0	130	130	nil	SATISFACTORY -E	nil
bharathi	15	m	left	left	type III	4	6	closed	5	125	130	nil	SATISFACTORY -E	nil
ram kumar	6	m	right	right	type III	6	8	closed	15	120	135	nil	SATISFACTORY -E	nil
jana	7	m	right	left	type III	3	6	closed	5	130	135	NE	UNSATISFACTORY	yes

DAILY ACTIVITY FUNCTIONAL LIMITATION	INITIAL PIN CONFIGURATION	POST OPERATIVE LOSS OF REDUCTION	PIN TRACT INFECTION	Mode of injury	Bauman angle loss	primary splintage	Displacement	followup
Nil	2l 1 m	Nil	Nil	fall	4	yes	PM	4
Nil	2l 1m	Nil	Nil	rta	5	yes	PL	6
Nil	2l 1m	Nil	yes	fall	5	no	PM	5
Nil	2l 1m	Nil	Nil	fall	6	yes	PM	7
Nil	1l 1m	Nil	Nil	fall	5	yes	PM	9
Nil	2l 1m	Nil	Nil	fall	4	yes	PM	7
Nil	1l 1m	Nil	Nil	fall	6	yes	PM	5
Nil	1l 1m	Nil	Nil	rta	5	yes	PM	6
Nil	2l 1m	Nil	Nil	fall	6	no	PM	5
Nil	2l 1m	Nil	Nil	fall	4	no	PM	4